ABSTRACTS OF NORTH AMERICAN GEOLOGY

June 1967

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1967

UNITED STATES DEPARTMENT OF THE INTERIOR

STEWART L. UDALL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402. Price 45 cents (single copy). Subscription price: $5.00 a year (12 monthly issues); $1.25 additional for foreign mailing. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (December 8, 1965).

(exp. 12-68)

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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

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A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey, Washington, D. C. 20242.

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ABSTRACTS

0086 **Abbott, Patrick Leon.** The Glen Rose section in the Canyon Reservoir area, Comal County, Texas [abs.]: Houston Geol. Soc. Bull., v. 9, no. 6, p. 19, 1967.

0094 **Ahrenholz, H. William.** Rock mechanics in 1966: Mining Eng., v. 19, no. 2, p. 99–104, illus., 1967.

This is a review article covering recent developments in fundamental research, techniques for field testing, and some of the more notable applications of rock mechanics at mining properties.—F.C.C.

0098 **Ahrenholz, H. William.** Coal in 1966: Mining Eng., v. 19, no. 2, p. 91–92, 1967.

The coal industry had another prosperous year in 1966 but formidable problems—competition, adverse legislation, shortage of skilled personnel—are looming ahead. Atomic energy is now a serious contender for the utility market.—F.C.C.

9763 **Alcock, Frederick J.** Morley Evans Wilson, 1881–1965: Royal Soc. Canada Minutes Proc. 1966, 4th ser., v. 4, p. 123–124, portrait, 1966.

9503 **Alder, B. J.** Is the mantle soluble in the core?: Jour. Geophys. Research, v. 71, no. 20, p. 4973–4979, table, 1966.

It is pointed out through the application of elementary solubility theory that, at the mantle–core interface conditions of 1.35 Mb and a temperature of 4,400°K (estimated solely from the measured seismic velocities), magnesium oxide could be soluble to an extent of about 10 percent in liquid iron. Such solubility considerations put stringent constraints on the chemical constitution of the Earth because, for example, neither SiO_2 nor Mg_2SiO_4 is calculated to be sufficiently soluble to lower the density of the liquid core significantly below that of pure iron.—Author's abstract

9805 **Alf, Raymond M.** Mammal trackways from the Barstow Formation, California: Southern California Acad. Sci. Bull., v. 65, no. 4, p. 258–264, illus., 1966.

Mammal footprints and trackways are described from the upper Miocene Barstow Formation of the Mojave Desert, California; most of them are in the Badlands, 10 miles north of Barstow, in Rainbow Basin, Owl Canyon and eastward toward the Camp Irwin Road. A large carnivore track, probably Amphicyon, was found in mudstone in Owl Canyon. At Rainbow Basin in a mud on a tuffaceous sandstone are numerous footprints of camels, cats, and a few antelopes. Other camel prints were found throughout the eastern part of the Barstow syncline, as natural casts in sandstone, volcanic ash, and limestone. A few prints of an artiodactyl, probably Merycodus, and several prints of a bird were found.—M.S.T.

9624 **Allen, E. P.; Wilson, W. F.** Newly recovered samples of basement rock from the North Carolina coastal plain [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 82, no. 2, p. 91–92, 1966.

9500 **Allingham, John W.** Aeromagnetic anomalies in the Bonne Terre area of the southeast Missouri mining district, *in* Mining geophysics—V. 1, Case histories. Tulsa, Okla., Soc. Explor. Geophysicists, p. 36–53, illus., table, 1966.

Analytical methods used in this study of total-intensity aeromagnetic data intensify the low-amplitude anomalies associated with buried hills and ridges of resistant Precambrian granitic and volcanic rocks. The hills and ridges, by controlling Cambrian sedimentary structures, localized lead deposits in overlying carbonate strata. The observed total-intensity aeromagnetic field was continued downward toward its source, vertical derivatives were calculated, and residual anomalies were separated by use of an electronic digital computer. Of these methods, continuation downward to the level of the Precambrian surface yields the best correlation with extensive mine workings in the lead district. The relations between ore deposits and magnetic anomalies continued downward, as established in areas of reliable subsurface control, are useful guides for exploring stratigraphically favorable areas elsewhere in the Ozark uplift.—Author's abstract

9922 **Alsop, L. E.; Nowroozi, A. A.** Faster Fourier analysis: Jour. Geophys. Research, v. 71, no. 22, p. 5482–5483, table, 1966.

A recent algorithm (Cooley and Tukey, 1965) is pointed out which considerably reduces the time required for Fourier analysis. As an example, a strain seismograph record obtained after the large Rat Island earthquake of February 4, 1965 (M = 7 3/4) was analyzed, using the "fast Fourier transform" and also a specially prepared Fourier analysis program which purposely sacrificed speed for accuracy. The difference in time required for the analysis (2.4 sec for the fast Fourier transform as compared with 156.7 sec for the conventional) was greater than predicted, while the two spectrums obtained were identical. The algorithm program for an IBM 7094 is available.—D.B.V.

Alsop, L. E. *See* vanVeen, H. J. 9924

0048 **Anders, Robert B.** Ground-water resources of Sabine and San Augustine Counties, Texas: Texas Water Devel. Board Rept. 37, 115 p., illus., tables, 1967.

Rocks underlying Sabine and San Augustine Counties are composed of sand, silt, and clay, and contain lesser amounts of glauconite and lignite. The important aquifers are in the Carrizo Sand and Wilcox Group, the Sparta Sand, and the Yegua Formation. Precipitation on outcrops of aquifers is the primary source of recharge. The aquifers are full and about 46 mgd is presently moving downdip through the important aquifers. Estimates indicate that the four main aquifers are capable of supporting a total perennial ground-water development of at least 44 mgd and possibly as much as 165 mgd. Quality of water is generally acceptable for most uses.—*from* Author's abstract

Andersland, O. B. *See* Dillon, Howard B. 9734

9667 **Anderson, Charles A.** Memorial to Louis Ehrhart Reber, Jr. (1889–1966): Geol. Soc. America Bull., v. 77, no. 12, p. P233–P236, portrait, 1966.

9515 **Anderson, Orson L.** A proposed law of corresponding states for oxide compounds: Jour. Geophys. Research, v. 71, no. 20, p. 4963–4971, illus., table, 1966.

Recent measurements show that there is a pressure P^* for Al_2O_3 and for MgO at which the density and bulk modulus are the same as in stishovite at room temperature. It can be shown that the properties of MgO at 205 kb are equivalent, in this sense, to those of Al_2O_3 at k atm. Data on other oxide compounds reveal the same trend. The following law of corresponding states is therefore proposed as a working hypothesis for mechanical properties of the Earth's mantle: The value of specific volume and bulk modulus of one oxide compound can be converted to the corresponding quantities appropriate to another oxide compound by a change in scale of either pressure or temperature.—D.B.V.

Anderson, Orson L. *See* Soga, Naohiro. 9897

Anderson, S. B. *See* Carlson, C. G. 9584

Anderson, W. B. *See* Crain, E. R. 9604

0055 **Anikouchine, William A.** Dissolved chemical substances in compacting marine sediments: Jour. Geophys. Research, v. 72, no. 2, p. 505–509, illus., 1967.

A mathematical model is devised to describe the depth distribution of concentration of various chemical species dissolved in the interstitial water of marine sediments, which includes not only the effects of diffusion, reaction, and moving space coordinates as do earlier models, but also makes provision for the movements of interstitial water caused by compaction of the sediments. The resulting equation is solved to obtain a steady-state distribution of dissolved silicate and the diffusive flux of dissolved manganese across the sediment–water interface; agreement between theoretical predictions and empirical data is found. The validity of the assumptions used in developing the model is discussed.—D.B.V.

Appleyard, E. C. *See* Hewitt, D. F. 9698

9542 **Armbrustmacher, Theodore Joseph.** Mafic dikes of the Clear Creek drainage area, eastern Bighorn Mountains, Wyoming [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1508B, 1966.

Ash, Richard D. *See* Klinger, Robert R. 0043

9525 **Ashlock, Peter D.** The origin of the Hawaiian Orsillinae (Hemiptera–Heteroptera:Lygaeidae) [abs.], *in* Abstracts of papers related with biology—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 5: Tokyo, Sci. Counell Japan [Sec. 11], p. 11, 1966.

9791 **Austin, Carl F.** Selection criteria for geothermal prospects, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. C: Nevada Bur. Mines Rept. 13, pt. C, p. 93–125, illus., 1966.

Future development of geothermal fields may modify the concepts for prospecting steam and metal rich brines presented here as guidelines for exploration at present, and will emphasize areas for research. Selection of prospects from the welter of springs and many volcanic areas of the western United States requires four steps to decide: (1) on the basis of literature, surface studies, and verbal reports, if interesting prospects occur; (2) which prospects are apt to be practical; (3) on the basis of structure, heat flow, and chemistry, which type is present, approximate size, and possible products; and (4) whether or not products could be marketed. Emphasis is placed on the problem of waste disposal and on estimation of the size, type, and potential products of a prospect. An extensive bibliography is included.—G.D.C.

0049 **Aylmore, L. A. G.; Karin, Mesbahul; Quirk, J. P.** Adsorption and desorption of sulfate ions by soil constituents: Soil Sci., v. 103, no. 1, p. 10–15, table, 1967.

The shape and reversibility with respect to concentration of the adsorption isotherms for sulfate ions on hematite, pseudoboehmite, and kaolinite clay have been examined. The isotherms for hematite and pseudoboehmite are almost completely irreversible with respect to equilibrium concentrations. The isotherm for the kaolinite clay exhibit two distinct regions of adsorption and are largely reversible with respect to equilibrium concentration. The proportions of clay minerals in soils are likely to be much higher than those of iron and aluminum oxides.—J.W.H.

9811 **Aylmore, L. A. G.; Quirk, J. P.** Adsorption of water and electrolyte solutions by kaolin clay systems: Soil Sci., v. 102, no. 5, p. 339–345, illus., tables, 1966.

The swelling of homoionic kaolin clay cores has been examined in relation to hydrostatic suction, electrolyte concentration, specific surface area, and exchangeable cation. The outstanding feature of the data is the lack of correlation between solution contents and the physico-chemical characteristics of the clay systems. Swelling appears to be governed by variation in the structural strength of the clay matrix.—J.W.H.

9499 **Bacon, Lloyal O.** Refraction seismic case histories in mining geophysics, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 105–113, illus., 1966.

Refraction seismic surveys [Iron River district and Negaunee area, Michigan] for determination of bedrock topography for a plant site, emplacement of service lines in a town site, and location of bedrock control of surface water in mine water control problems are discussed. The effect of velocity inversion in the latter case shows that bedrock topographic effects are amplified by the variation in thickness of the low velocity layer and that fairly reliable results can be obtained with empirical corrections based on available drill hole data. Seismic refraction methods provide a maximum amount of information on bedrock topography in a minimum of time, with a precision of about ±10 percent of actual depth. The cost of the seismic survey in each case was of the order of the cost of drilling one hole to the maximum overburden depth.—*from* Author's abstract

Badcock, J. *See* Martin-Kaye, P. 9905

Bailey, B. V. *See* Cooke, D. L. 9885

0099 **Balsley, J. R.; Smith, C. W.** (compilers). Aeromagnetic map of the Rousseau quadrangle, Ontonagon and Houghton Counties, Michigan: U.S. Geol. Survey Geophys. Inv. Map GP-606, scale 1:62,500, 1967.

0101 **Balsley, J. R.; Smith, C. W.** (compilers). Aeromagnetic map of the Kenton quadrangle, Gogebic, Ontonagon, Iron, and Houghton Counties, Michigan: U.S. Geol. Survey Geophys. Inv. Map GP-604, scale 1:62,500, 1967.

0102 **Balsley, J. R.; Petrafeso, F. A.** (compilers). Aeromagnetic map of the Pelkie quadrangle, Baraga and Houghton Counties, Michigan: U.S. Geol. Survey Geophys. Inv. Map GP-599, scale 1:62,500, 1967.

0103 **Balsley, J. R.; Smith, C. W.** (compilers). Aeromagnetic map of the Sidnaw quadrangle, Houghton and Baraga Counties, Michigan: U.S. Geol. Survey Geophys. Inv. Map GP-601, scale 1:62,500, 1967.

9757 **Barber, N. F.** Fourier methods in geophysics, *in* Methods and techniques in geophysics, V. 2: London and New York, Interscience Publishers, p. 123–204, illus., 1966.

Fourier methods in geophysics are examined through a discussion of their application to analysis of polar wandering by both Fourier series and Fourier integral representation, of tides and of free vibrations of the Earth as an elastic body by scalar Fourier expressions, and of 'noise' signals such as gravity waves generated by wind on the sea, and in design of directional arrays used in sound studies or seismic exploration. A list of 34 references is included.—V.S.N.

Barnes, William C. *See* Smith, A. Gilbert. 9768

Barr, David A. *See* Hansen, Don A. 9724

9870 **Barr, K. W.** A cross-section through the Northern Range of Trinidad, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 27–33, illus., 1966.

The Northern Range of Trinidad is the continuation of the Sierra de la Costa of Venezuela, and the extreme eastern ramification of the Andean fold mountain system. Along the Blanchisseuse–Arima Road, crossing the range, a series of cuts allows study of the Jurassic–Cretaceous Caribbean Series. The Series has been divided into four formations, each of which is described; all are metamorphosed sandstone and shale. The proposed interpretation of the structure consists of an overfold complex directed toward the north with an anticlinal core zone thrust over an overturned syncline. Later, strong regional strike faulting cut the south flank. Two alternative structure types are considered briefly. Geologic sketch maps and sections are included.—E.S.L.

Bass, Manuel N. *See* Lidiak, Edward G. 9767

9585 **Bass, Robert C.** Shock compression of porous magnetite: Sandia Corp., Albuquerque, N. Mex., Research Rept. SC-RR-66-547, 12 p., illus., tables, 1966.

In the study of shock compression of geologic materials, the effect of the porosity of the material is often the limiting factor in the determination of an equation of state for the material. Although various porous geologic materials have been investigated in the past, most were structurally rigid. In an attempt to obtain further experimental data to evaluate Hugoniot synthesis methods that might be useful for porous materials, the shock compression of magnetite sand, density 2.91 gm/cm^3, has been studied. Particle diameter of samples ranged from 0.15 mm (5 percent) to 1.22 mm (1 percent), with an average diameter of 0.3 mm.—*from* Author's introduction

9517 **Bates, Robert G.** Airborne radioactivity surveys, an aid to geologic mapping, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 67-76, illus., 1966.

Airborne radioactivity surveys aid in geologic mapping and exploration programs by furnishing generalized geologic information on large areas in a short period of time. The radioactivity data aid in the rapid compilation of a provisional geologic map by showing continuity of units between widely spaced ground reconnaissance traverses. Geologic units obscured by deep weathering can often be mapped by the radioactivity data. When used in conjunction with other types of geophysical information, the subsurface configuration of units can often be obtained. [Two areas selected to illustrate their use are the Valley and Ridge province of eastern Tennessee and Kentucky, and the Concord quadrangle in North Carolina.]—Author's abstract

9741 **Bean, R. J.** A rapid graphical solution for the aeromagnetic anomaly of the two-dimensional tabular body: Geophysics, v. 31, no. 5, p. 963-970, illus., 1966.

A graphical method of determining depth and other parameters of two-dimensional tabular bodies from aeromagnetic anomalies is outlined. The method uses the inflection and half maximum slope points of anomalies having two flanks or a single high gradient. The solution is obtained from the ratios of the distances between these points. Angles of dip, magnetization direction, and geomagnetic field inclination in the plane of the profile are combined into an apparent inclination angle. The method is especially suited for rapid interpretation of large aeromagnetic surveys by use of the observed profiles.—D.B.V.

9928 **Beckman, W. A., Jr.; Whitten, E. H. Timothy.** Statistical problems involved in remote sensing of the geology of the lithosphere-atmosphere interface: Jour. Geophys. Research, v. 71, no. 24, p. 5873-5890, illus., tables, 1966.

Use of electromagnetic data for remote sensing of geological attributes of the atmosphere-lithosphere interface introduces numerous statistical problems. A multivariate approach is necessary. Experiments must be designed to ensure that the several available sensors actually sense precisely the same population of samples simultaneously. Statistical study of 20 attributes of the surficial rocks at a test site illustrates the extreme variability of the interface and demonstrates that, with present methods, correlation of information about the interface and the near-surface geology may be misleading.—*from* Authors' abstract

0087 **Bedinger, M. S.** An electrical analog study of the geometry of limestone solution: Ground Water, v. 5, no. 1, p. 24-28, illus., 1967.

An electrical analog was constructed conforming to the conditions found in limestone terranes in the eastern and central United States and has been used to define the pattern, velocity, and density of ground-water flow and the relative length of time of contact of water with the aquifer. Successive models are used to illustrate progressive limestone solution and changes in ground-water flow in the aquifer. Results of the study indicate that the most active zone of solution is at shallow depths beneath the water table and near the point of discharge, consequently the

size of channels decrease with depth and increase with proximity to the point of discharge; solution channels have a greater lateral than vertical extent.—*from* Author's abstract

Behrens, E. William. *See* Milling, Marcus E. 9713

Bell, R. T. *See* Smyth, J. R. 9536

9529 **Bell, R. Thomas; Smyth, Joseph R.; Hege, E. K.** A device for the study of cathodoluminescence [abs.], *in* Virginia Acad. Sci. Proc. 1965–66: Virginia Jour. Sci., new ser., v. 17, no. 4, p. 260, 1966.

9697 **Bennett, G.; Brown, D.; George, P.** Kesagami Lake sheet, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P. 371, scale 1 in. to 2 mi., 1966.

9701 **Bennett, G.; Brown, D.; George, P.** Cochrane sheet, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P. 372, scale 1 in. to 2 mi., 1966.

9716 **Benson, Anthony L.** Devonian stratigraphy of western Wyoming and adjacent areas: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 12, p. 2566–2603, illus., tables, 1966.

Devonian rocks are present throughout western Wyoming, southwestern Montana, and eastern Idaho. The classic Devonian units, the Jefferson and Three Forks Formations of Montana are correlated and discussed for the area of the northern Rocky Mountains. These formations are truncated eastward in Wyoming and are overlain by an unnamed dark shale unit of Devonian and Mississippian age. A.E.R.

9857 **Berg, Orville Roger.** Depositional environment of a portion of the Bluejacket Sandstone, Mayes County, Oklahoma: Shale Shaker, v. 17, no. 3, p. 50–54, illus., table, 1966.

The Bluejacket and its subsurface equivalent, the Bartlesville, have been postulated because of the cross bedding to be sands deposited by Pennsylvanian rivers, or beach deposits. In the study area, the sandstone, a member of the Bluejacket coal cycle, outcrops as an east-facing escarpment. The shape of the sandstone body was determined by measuring vertical sections, and constructing a fence diagram. It has a thick phase (42–55 feet) and a thin phase (4–15 feet). The major change in thickness occurs at the base where the sandstone is unconformable with an underlying shale which thickens as the sand thins; the upper contact is conformable. The thick and thin phases displayed no differences in sedimentary structures, but the thick phase has coarser grains. A cross section of the Bluejacket is compared with three common types of lenticular sand bodies and found to resemble most closely a channel sand with a sheet phase.—E.S.L.

9883 **Bergey, W. R.** Geochemical prospecting for copper in Puerto Rico, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 113–119, illus., 1966.

More than 25,000 samples of soil and stream sediment were analyzed as part of a long-range exploration program. Stream sediment sampling was employed with aeromagnetic surveying and reconnaissance geological mapping in the rapid evaluation of an area of more than 1,000 sq mi. Geochemical soil surveys were made principally in localities of particular interest which were indicated by the reconnaissance methods. It is concluded that stream sediment analysis is particularly useful in locating large areas of porphyry copper-type mineralization but may fail to detect smaller deposits such as high-grade veins and skarn-type replacements. Anomalous metal values in the soil accurately delineate the zones of copper mineralization and serve as targets for diamond drilling. Molybdenum appears to be particularly useful as a pathfinder element for certain types of deposits.—*from* Author's abstract

9904 **Berryhill, Henry L., Jr.** Lithology and tectonic implications of Upper Cretaceous clastic volcanic rocks, northeast Puerto Rico, *in* Caribbean Geol. Conf., 3d,

Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 34–40, 187, illus., 1966.

The Upper Cretaceous sequence consists of well-bedded pyroclastic and detrital volcanic rocks having an aggregate thickness of more than 20,000 feet. The reddish siliceous lutite and much of the calcilutite, in the lower part, were examined to demonstrate lithology of water-laid volcanic detritus adjacent to oceanic volcanism, sedimentary processes, and paleogeographic elements. Petrology of reworked tuffs suggests that water was the main transporting agent. Evidence of cyclic deposition is abundant; the chief factor seems to be variation in rainfall, rather than intermittent volcanism. The rocks were deposited in a relatively deep basin in which subsidence was contemporaneous with deposition. Some Turonian rocks contain large slab-like fragments of water-laid tuff older than the enclosing rocks, which imply tectonic uplift and erosion of an older volcanic sequence, possibly early Cretaceous.—*from* Author's abstract

Bhappu, R. B. *See* Deju, R. A. 9933

Bidwell, L. E. *See* Cotter, R. D. 9711

9541 **Biggers, James Virgil.** Experimental determination of some thermodynamic properties of oxide solid solutions containing manganese oxide and cobalt oxide [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1500B, 1966.

9668 **Blackadar, R. G.** (editor). Report of activities, November 1965 to April 1966: Canada Geol. Survey Paper 66-2, 73 p., illus., table, 1966.

This report consists of 39 short papers that present results of scientific studies in both field and laboratory carried out by members of the Canada Geological Survey during the period November 1965–April 1966. Many are interim reports on research that will be more fully described later.—E.S.L.

Blackwelder, B. W. *See* Menzies, R. J. 9906

9530 **Blair, J. A.** Structural contouring of the Saltville Fault in southwestern Virginia [abs.], *in* Virginia Acad. Sci. Proc. 1965–66: Virginia Jour. Sci., new ser., v. 17, no. 4, p. 315, 1966.

Blanchard, Maxwell B. *See* Farlow, Neil H. 9837

9849 **Blume, Helmut.** Problemas de la topografía kárstica en las Indias Occidentales, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 255–265, illus., 1966.

Limestone and karst phenomena are widely scattered in the West Indies. Limestone in the Lesser Antilles is concentrated in the outer chain of islands, while the inner is of volcanic origin. The limestones are of different ages; the oldest, for example in Cuba, is Jurassic to Cretaceous; most are Eocene to Miocene, as in Jamaica and Puerto Rico; and on the margins are upper Pliocene to Pleistocene coraline gypsum, as on Barbados. In the Greater Antilles the limestones are variously stratified and often faulted. The distinction is made between the Kegelkarst (conical form) abundant in pure limestone and the dinaric karst (common solution form) found in impure limestone. Kegelkarst is typical of the humid or semihumid tropical climate of the West Indies.—G.D.C.

Blyth, C. R. *See* Graf, D. L. 0050

9539 **Bogard, Donald Dale.** Krypton anomalies in achondritic meteorites [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1438B, 1966.

9586 **Bogdanov, Yu. V.; Gur'yanova, V. N.; Mirayes, M.** Metallogenicheskiy ocherk mednykh mestorozhdeniy Kuby: Sovetskaya Geologiya 1965, no. 11, p. 91–103, illus., 1965; English translation, Internat. Geology Rev., v. 8, no. 10, p. 1218–1225, illus., 1966.

Copper deposits of Cuba belong to the Jurassic lead–zinc–copper, Cretaceous copper, and Paleogene copper complexes, which differ substantially in their formation conditions. The island is differentiated into a number of metallogenic zones formed at the initial and early stages of the Cuba folded province. Pinar del Rio, Pinos, Trinidad and Oriente zones, of an intrageanticlinal nature, are prospective with respect to copper vein deposits of the lead–zinc–copper complex. The Sasa and Cauto zones, intrageosynclinal, are prospective with regard to copper-pyrite and copper veins deposits of the Cretaceous complex. A metallogenic study of the island is indicated in planning the exploration of its copper prospects.—AGI Staff abstract

Bollinger, G. A. *See* Stauder, W. M. 9833

9930 **Bolt, Bruce A.; Nuttli, Otto W.** P-wave residuals as a function of azimuth—[Pt.] 1, Observations: Jour. Geophys. Research, v. 71, no. 24, p. 5977–5985, illus., tables, 1966.

Observations of P-wave delay time, relative to Berkeley, at 12 stations in central and northern California indicate a cyclic dependence on azimuth at some stations. The group of stations in or near the eastern edge of the Great Central Valley shows greatest azimuthal variation. A northern group of Coast Range stations shows no significant azimuthal dependence, whereas a southern group does. Results are pertinent to construction of revised P-wave traveltime tables. They also indicate that harmonic analysis of empirical azimuth–anomaly functions may provide a novel means of determining regional variations in the parameters of the crust and upper mantle.—D.B.V.

Bonet, F. *See* Butterlin, Jacques. 9877

9719 **Bork, Kennard B.** Geomorphology and glacial geology of Indiana, *in* A survey of Indiana geology [revised edition]: Bloomington, Ind., Sigma Gamma Epsilon, Rho Chapter, Indiana Univ. Dept. Geology, p. 65–74, illus., 1966.

Seven of nine regional physiographic provinces defined by Malott (1922) are controlled by north-northwest striking Paleozoic strata that dip 20 to 30 feet per mile westward. The bedrock, except in the southern two-fifths of Indiana, is obscured by glacial drift which thickens northward to more than 500 feet. The characteristics of each of the geomorphic units make it apparent that they coincide with dominant mapped lithologies. The Mitchell Plain underlain by soluble limestones differs greatly from uplands to the east and west, which are developed on resistant sandstones and siltstones. Of the four major Pleistocene ice advances, the Illinoian glaciation was most widespread in this region. Bedrock control is evident locally, in particular the diversion of ice lobes by the Knobstone Escarpment.—G.D.C.

9607 **Bostrom, Robert.** Theory on island movement related to San Juan cable break: Trend Eng., v. 18, no. 4, p. 15–16, 1966.

Breaks in the electric cable on the floor of Rosario Strait between two of the San Juan Islands, Washington, in 1964 and 1965 suggests that this might be the place to install a strain gage in connection with a project to monitor possible changes in distances between the San Juans, the Seattle area, and the Olympic Peninsula over a period of years. An acoustic-pulse profiler would first be used to discover if the strait floor is faulted. The East Pacific Rise, in leaving the continent, may be causing the Olympic Peninsula and Vancouver Island to separate from the mainland.—E.S.L.

9751 **Boucot, A. J.; Johnson, J. G.; Harper, Charles; Walmsley, Victor G.** Silurian brachiopods and gastropods of southern New Brunswick [with French, Russian, and German abs.]: Canada Geol. Survey Bull. 140, 45 p., illus., 1966.

Shelly faunas of southern New Brunswick and the adjacent part of Maine span a considerable portion of Silurian time. The succession comprises a lower fauna, relatively rich in genera and species of Upper Llandovery and Wenlock age; a middle shelly fauna, relatively poor in genera and species characterized by an abundance

of *Salopina*, rhynchonellids, and *Howellella* of Wenlock or Ludlow age; and an upper fauna, sparse and poorly dated but occurring near the Silurian–Devonian boundary. The total fauna, described and figured, is assigned to 37 existing genera.—Authors' abstract

9847 **Boucot, A. J.; Gauri, K. L.; Johnson, J. G.** New subfamily Proschizophoriinae of dalmanellid brachiopods [with German abs.]: Paläont. Zeitschr., v. 40, nos. 3–4, p. 155–172, illus., 1966.

Proschizophoria Maillieux is restudied and found to be related to the Silurian genus *Idiorthis* McLearn and a new genus *Cordatomyonia*, type species *C. shuperi, n.sp. Proschizophoria, Idiorthis, and Cordatomyonia* are united in the new subfamily Proschizophoriinae assigned to the dalmanellid family Rhipidomellidae. This family and its included subfamilies are emended and newly diagnosed. A new dalmanellid genus, *Megasalopina* is proposed for the Lower Devonian species *"Dalmanella" elevata* Williams and Breger and its allies; it is derived from draboviinid genus *Salopina* Boucot and therefore belongs to Schizophoriidae. *Dalmanellopsis* Khalfin is removed from *Levenea* and is shown to be related to *Salopina.—from* Authors' abstract

9866 **Bowen, Robert.** Paleotemperature analysis: Amsterdam and New York, Elsevier Publishing Co. (Methods in Geochemistry and Geophysics, 2), 265 p., illus., tables, 1966.

The use of oxygen isotopes in carbonate analysis has contributed greatly to knowledge of paleoclimates, and the technique has been successfully applied to the study of Recent organisms. This book describes the conception and practical beginnings of the method, and summarizes progress to date. Details of initial mistakes as well as research results modified by later work are included, to illustrate the difficulties encountered and their removal as additional data were accumulated. Results are presented on a world-wide stratigraphic basis and relevant chapters include all significant material published to the autumn of 1965, including the attempt to utilize the phosphate thermometer in order to eliminate uncertainty concerning the isotopic composition of water in paleo-oceans.—G.D.C.

9681 **Bradley, W. H.** Tropical lakes, copropel, and oil shale: Geol. Soc. America Bull., v. 77, no. 12, p. 1333–1337, illus., table, 1966.

Four shallow lakes have been found (two in Florida, two in Africa) that are producing the kind of organic ooze that is judged to be a modern analog of the precursors of rich oil shale such as the Green River Formation. The ooze in all four is predominantly algal, entirely in the form of minute fecal pellets, and does not decay in warm wet oxidizing environments. The algal ooze at a depth of three feet below the mud-water interface has a C–14 age of 2280±200 yr. If compacted, the 3-ft layer would be only 0.5 in thick. Air-dried algal mud looks much like oil shale and has a C–H ratio essentially like that of the organic matter in oil shale.—J.P.A.

Brandvold, L. A. *See* Summers, W. K. 0107

9754 **Branson, Carl C.** Patterns of Oklahoma prairie mounds: Oklahoma Geology Notes, v. 26, no. 11, p. 263–273, illus., 1966.

Numerous prairie mounds, ranging from three to seven feet in height and 30 to 100 feet in diameter, occur in the southeastern part of Oklahoma. Occurrence on all Pleistocene terrace levels indicates formation during late Wisconsin time. Most are in random arrangement and are circular in plan. The rare areas of different arrangement provide exceptions which make it difficult to explain their origin. A series of aerial photographs illustrates several nonrandom mound patterns.—B.S.H.

9935 **Branson, Carl C.** Recent cutoffs on the Kiamichi River: Oklahoma Geology Notes, v. 26, no. 12, p. 286–288, illus., 1966.

Aerial photographs are used to illustrate the history of recent meander cutoffs on the Kiamichi River in Pushmataha and Choctaw Counties, Okla.—B.S.H.

9507 **Brant, A. A.; Dolan, W. M.; Elliot, C. L.** Coplanar and coaxial EM tests in Bathurst area, New Brunswick, Canada, 1956, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 130–141, illus., 1966.

Tests across conductive graphite and sulfide zones in New Brunswick during 1956 with coplanar and coaxial coil systems showed that the in- and out-of-phase response curves varied in form with coil separation relative to body width and depth. Quantitative interpretation is made using later developed interpretative diagrams.—Authors' abstract

9723 **Brant, Arthur A.; Newmont Exploration Staff.** Examples of induced-polarization field results in the time domain, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 288–305, illus., table, 1966.

Examples of IP field results in the time domain [from the western United States, Peru, and Africa] are presented showing field data from sulfides associated with chalcopyrite, syngenetic sulfides in shales, the high response from bentonitic tuffs, and the response from free magnetite. The problems of coupling and wall invasion are discussed for drill holes and examples of drill hole work and the application of the corrections are presented.—Authors' abstract

9862 **Brecher, Henry H.** Surface velocity measurements on the Kaskawulsh Glacier, Yukon Territory, Canada: Ohio State Univ. Inst. Polar Studies Rept. 21, 73 p., illus., tables, 1966.

Positions of 24 markers on the upper north arm of the Kaskawulsh Glacier were determined by intersection or resection on five occasions between July 12 and August 14, 1964. Surface velocities over four time periods of several days and two two-week periods were computed from the position determinations and compared to mean seasonal velocities. It was found that differences from mean seasonal values are randomly distributed. Annual velocities of three markers along the glacier centerline appear to be very slightly larger than summer velocities. An analysis of the errors in the results indicates that the errors in velocity differences are generally about as large as the apparent differences. It is concluded that there are no significant differences from mean seasonal velocities over the short time interals.—Author's abstract

0017 **Breland, James E.** Coal mine production, *in* Coal in 1966: Mining Eng., v. 19, no. 2, p. 92–94, illus., 1967.

Bituminous coal production for 1966 is estimated at 537 million tons, an increase of 5.4 percent over 1965. Approximately two thirds of the total was mined underground.—F.C.C.

9531 **Brewer, J. E.** Influence of geology on the location and design of Gathright Dam [abs.], *in* Virginia Acad. Sci. Proc. 1965–66: Virginia Jour. Sci., new ser., v. 17, no. 4, p. 315–316, 1966.

9603 **Brietkrietz, Alex.** Basic water data report No. 3, Kalispell Valley, Montana: Montana Bur. Mines and Geology Bull. 53, 25 p., illus., tables, 1966.

The report contains water records collected and compiled during 1963–65 by the U.S. Geological Survey during the course of an investigation of Kalispell Valley water resources. It makes available basic data useful in planning wise development and proper management of water resources, and supplements an interpretive report to be published later as a bulletin in the same series. A map shows locations of wells, springs, and pothole lake measurement sites. Tabulated data are: records of wells and springs, drillers' logs of wells, and water levels in observation wells and pothole lakes in Kalispell Valley.—M.C.M.

9873 **Briggs, Reginald P.** The blanket sands of northern Puerto Rico, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 60–69, illus., table, 1966.

Blanket sands, composed of quartz and reddish-brown clay in greatly varying proportions, cover approximately 400 sq km in unconnected deposits within a 126 by 16 km band parallel to the north coast. The deposits, averaging at least 4 m in thickness, overlie limestone, chalk, and marl. Karst is well developed in the southern part while the north is subdued and hummocky. Most of this material was initially derived from volcanic and plutonic rocks in the mountainous interior. When the limestone terrane rose above sea level beginning in middle Miocene, major consequent streams were able to incise valleys and carry sediment to the retreating sea; all other drainage became subterranean. Because there was no surface drainage, the sand blanket left by the sea remained, was trapped in developing karst, and subjected to tropical weathering. The Santurce Sand is here extended to include all blanket sands.—E.S.L.

9641 **Bright, James H.** The California asbestos industry, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. B: Nevada Bur. Mines Rept. 13, pt. B, p. 1–10, illus., 1966.

This semi-technical paper presents some of the general features of the California asbestos industry; a generalized map shows the distribution of serpentine in the State, and principal deposits of asbestos, which have been mined in small quantities since 1882. There are currently five chrysotile asbestos producers, of which the largest operation is in the Coalinga area—the New Idria serpentine plug in the Diablo Range. This outcrop is about 13 miles long and 4 miles wide, sheared to chips with interwoven mats of weak but very white chrysotile fibers in flexible flakes. Asbestos was once considered a waste material in chrome pits but is now recognized as an industrial mineral with current price ranging from sixty to one hundred and twenty dollars per ton; reserves of the district are several billion tons.—G.D.C.

9543 **Brimhall, Willis Hone.** Concentration distributions of uranium, thorium and some alkali, alkaline earth and transition metals in three cores of Conway Granite, New Hampshire [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1509B, 1966.

9505 **Broecker, Wallace S.** Glacial rebound and the deformation of the shorelines of proglacial lakes: Jour. Geophys. Research, v. 71, no. 20, p. 4777–4783, illus., table, 1966.

A simple isostatic model explaining the pattern of deformation of shorelines of proglacial lakes is developed. The rate of glacial retreat before the formation of the shoreline can be derived from the curvature of its uplifted portion. A rate of 120 km per 10^3 yr is calculated for the retreat preceding the formation of Lake Algonquin. Implications of this model are: (1) the continental ice sheets during retreat were not unlike the present Greenland and Antarctic ice masses; (2) rebound at the edge of a continental ice sheet is a simple isostatic process occurring with a time constant of about 700 yr; (3) the lateral influence of an ice sheet extends no more than a few tens of kilometers beyond its margins.—D.B.V.

Brooks, C. *See* McIntyre, G. A. 9737

Brooks, C. K. *See* Fawcett, J. J. 9826

Brown, D. *See* Bennett, G. 9697

Brown, D. *See* Bennett, G. 9701

9787 **Burke, C. F., Jr.; Ediger, N. M.** Collating exploration data: Oilweek, v. 17, no. 39, p. 16, 18–19, illus., 1966.

The organization of the Committee on Storage and Retrieval of Geological Data in Canada is reviewed. Eight subcommittees are investigating various facets of data storage. The objective of the Fossil Fuels Subcommittee is to recommend standards by which a fossil fuels deposit should be geologically described. Problems faced included: how best to define a deposit, what items of geological data adequately describe it, and what standards of measurement or description should be applied to the selected descriptors. When basic geologic data are selected, they are generally difficult to find in ordinary sources, and the data may be given in differing

terminology or units of measurement. A pilot study was done of 610 gas pools in western Canada, and distribution maps were drawn. Rose diagrams showing orientation of 84 pools were constructed and show some well defined trends.—E.S.L.

9672 **Burns, D. J.** The formation of bauxite and karst topography in Eufaula district, Alabama, and Jamaica, West Indies [discussion of paper by O. M. Clarke, Jr. 1966]: Econ. Geology, v. 61, no. 8, p. 1458–1459, 1966.

Because of "the very low percentage of the R_2O_3 group in the White Limestone . . . it is very doubtful whether components of this group can be accurately determined by routine carbonate rock analysis using a normal weight of sample." (See Clarke, ibid., v. 61, p. 903–916, 1966).—*from* Author's text

9877 **Butterlin, Jacques; Bonet, F.** Les formations Cenozoiques de la partie Mexicaine de la presqu'île du Yucatan [with English abs.], *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 75–90, illus., geol. map, 1966.

The first part of the paper, by both authors, presents the stratigraphy of the Yucatán Peninsula. Six formations are described, the Chichen-Itza Formation and Mollusk Limestone being named here for the first time; the former is divided into three members. The most important result of the study was the discovery that Eocene (mostly middle) limestone constitutes more than half the area, which was formerly considered to be Miocene to Recent. The second part, by Butterlin, presents the paleogeography of the southern border of the Gulf of Mexico during Eocene Oligocene time as reconstructed from study of Foraminifera from wells. The Yucatán Peninsula acted as a continental platform. Paleogeographic maps are included.—E.S.L.

0054 **Bye, Albert E.** St. Francisville geodes with filiform pyrite: Gems and Minerals, no. 352, p. 22–23, illus., 1967.

The geodes from the St. Francisville area, Missouri, have nailhead calcite crystals on quartz, and some contain filiform pyrite. Identification of this unusual form of pyrite was made by X-ray and spectrograph.—E.S.L.

Byrne, John V. *See* Kulm, L. D. 9669

9832 **Callahan, William H.** Paleophysiographic premises for prospecting for strata-bound base metal mineral deposits in carbonate rocks, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. C: Nevada Bur. Mines Rept. 13, pt. C, p. 5–50, illus., [revised] 1966; originally published 1965.

This paper is reprinted with slight modification from the CENTO [5th] Symposium volume, "Mining geology and the base metals", Ankara, Turkey, Central Treaty Organization, 1964.—G.D.C.

0047 **Camp, Charles L.; Gregory, Joseph T.; Savage, Donald E.** Ruben Arthur Stirton, 1901–1966: Soc. Vertebrate Paleontology News Bull. 79, p. 60–61, portrait, 1967.

0020 **Canada Geological Survey.** Aeromagnetic map, Tyrrell Point, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3562, scale 1:63,360, 1967.

0021 **Canada Geological Survey.** Aeromagnetic map, Musclow Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3563, scale 1:63,360, 1967.

0022 **Canada Geological Survey.** Aeromagnetic map, Sheet 75 O/16, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3564, scale 1:63,360, 1967.

0023 **Canada Geological Survey.** Aeromagnetic map, Darrell Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3565, scale 1:63,360, 1967.

0024 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 B/3, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3566, scale 1:63,360, 1967.

0025 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 B/2, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3567, scale 1:63,360, 1967.

0026 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 B/1, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3568, scale 1:63,360, 1967.

0027 **Canada Geological Survey.** Aeromagnetic map, Moraine Lake North, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3569, scale 1:63,360, 1967.

0028 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 A/3, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3570, scale 1:63,360, 1967.

0029 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 A/2, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3571, scale 1:63,360, 1967.

0030 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 A/1, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3572, scale 1:63,360, 1967.

0031 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 B/6, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3573, scale 1:63,360, 1967.

0032 **Canada Geological Survey.** Aeromagnetic map, Healey Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3574, scale 1:63,360, 1967.

0033 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 B/8, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3575, scale 1:63,360, 1967.

0034 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 A/5, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3576, scale 1:63,360, 1967.

0035 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 A/6, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3577, scale 1:63,360, 1967.

0036 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 B/11, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3580, scale 1:63,360, 1967.

0037 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 B/10, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3581, scale 1:63,360, 1967.

0038 **Canada Geological Survey.** Aeromagnetic map, Tourgis Lake West, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3582, scale 1:63,360, 1967.

0039 **Canada Geological Survey.** Aeromagnetic map, Tourgis Lake East, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3583, scale 1:63,360, 1967.

0040 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 A/11, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3584, scale 1:63,360, 1967.

0041 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 A/10, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3585, scale 1:63,360, 1967.

0042 **Canada Geological Survey.** Aeromagnetic map, Hunger Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3586, scale 1:63,360, 1967.

9619 **Carey, Andrew G., Jr.** Studies on the ecology of benthic invertebrate fauna in the northeast Pacific Ocean off Oregon [abs.], *in* Abstracts of papers related with biology—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 5: Tokyo, Sci. Council Japan [Sec. 12], p. 21, 1966.

9584 **Carlson, C. G.; Anderson, S. B.** A look at the lower and middle Madison of northwestern North Dakota: North Dakota Geol. Survey Rept. Inv. 43, 14 p., illus., 1966.

Facies changes noted within the lower and middle Madison Limestone suggest the possibility of stratigraphic traps holding oil in northwestern North Dakota. These include changes from "clean" carbonates to argillaceous carbonates, fine-grained carbonates to finely crystalline, dense carbonates, and normal marine carbonates to silicified carbonates. Limited control hinders delineation of such traps at present, but future deep exploration should take into account such facies changes.—Authors' abstract

9771 **Carmichael, I. S. E.; Fyfe, W. S.; Machin, D. J.** Low spin ferrous iron in the iron silicate deerite: Nature, v. 211, no. 5056, p. 1389, illus., table, 1966.

The new mineral deerite, a hydrated ferrous-ferric silicate, was separated from a sample from Laytonville, Calif., the type locality. The temperature dependence of inverse magnetic susceptibility suggests that some of the ions present are in low spin configuration; it is shown that about 9 out of 13 ferrous ions are in low spin configuration. The magnetic properties of deerite show that low spin ferrous iron in oxygen coordination does not require extreme pressures and leaves little doubt that olivine or spinel phases in the mantle will contain iron in this diamagnetic state, as previously suggested (Fyfe, 1960).—D.B.V.

Carver, Robert E. *See* Sandy, John. 9831

9745 **Casagrande, L.** Settlement of a mat foundation on a thick stratum of sensitive clay [reply to discussion by G. A. Leonards, 1966]: Canadian Geotech. Jour., v. 3, no. 2, p. 102–103, 1966.

The points discussed by Leonards (ibid., p. 100–102, 1966) are commented on: (1) For this project (Leda clay, St. Lawrence River east of Montreal), a small variation in magnitude of the recompression index C_r is of secondary importance; of much greater influence is the decision whether the preconsolidation loads have been determined with reasonable accuracy. (2) Small load increments were used in consolidation tests to establish more accurately the preconsolidation ranges for test specimens. (3) Estimation of elastic compression of the clay stratum was not attempted; for more accurate analysis, an initial settlement of one inch or more should be considered. (4) The estimated 3-ft drop in ground-water level used in the settlement analysis is based on drop in mean river level between 1955 and 1963 and is believed realistic.—V.M.J.

0046 **Case, Jerry.** Collecting fossil vertebrates in Florida: Earth Sci., v. 20, no. 1, p. 10–12, illus., 1967.

Collecting possibilities along rivers, in lakes and springs, on beaches, and in limestone quarries and phosphate pits of Florida are described.—E.S.L.

Caster, Kenneth E. *See* Durham, J. Wyatt. 9910

9855 **Chenoweth, P. A.** Pennsylvanian slate-pencil sea urchin from the Oologah Limestone, Oklahoma: Oklahoma Geology Notes, v. 26, no. 12, p. 279–282, illus., 1966.

Fragments of an echinoid, probably of the genus *Archaeocidaris* were found in the Pawnee Limestone Member of the Oologah Formation (Pennsylvanian) in Tulsa County. The Pawnee Limestone in this area is composed of irregular beds of fossil calcilutite and calcarenite separated by thin partings of shale. Regional studies indicate that it changes rapidly to the south and becomes a calcareous shale and dolomitic calcilutite. These relationships and knowledge of the ecology of modern echinoids lead to the conclusion that the formation was deposited upon a shelf in shallow, probably normal marine waters.—B.S.H.

0058 **Chenoweth, Philip A.** Unconformity analysis: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 4–27, illus., 1967.

The shelf of a geosyncline or basin is an area in which there are commonly many unconformities. Unconformity analysis is a method of reconstructing a history of each and determining the relations of strata below and above each unconformity. Four situations are considered: (1) simple tilt, (2) differential tilt, (3) synclinal folding, and (4) anticlinal folding. Examples from Arkansas, Oklahoma, and Texas are described. The shelf is a region conducive to the migration of petroleum and its accumulation, most especially in stratigraphic traps. By careful unconformity analysis it is possible to determine the subsurface trend and width of potential producing zones below or above an unconformity.—W.L.A.

9816 **Chilton, Frank; Eisler, J. D.; Heubach, H. G.** Dynamics of spalling of the Earth's surface caused by underground explosion: Jour. Geophys. Research, v. 71, no. 24, p. 5911–5919, illus., 1966.

Theoretical investigation of the dynamics of spalling in near-surface earth layers caused by contained underground explosions show how spalling is a consequence of propagation of compressive and tensile stresses in the subsurface. The subsurface spalled region has an upper and a lower bound, and can be represented by a solid of revolution whose vertical axis passes through the shot point. Analysis of Rainier data reveals that the available tensile strength of rocks in place is 20 to 50 times smaller than the accepted value determined for laboratory samples.—D.B.V.

Christensen, J. *See* Delaney, J. R. 9662

9927 **Christensen, Nikolas I.** Elasticity of ultrabasic rocks: Jour. Geophys. Research, v. 71, no. 24, p. 5921–5931, illus., tables, 1966.

Ultrasonic measurements of compressional and shear-wave velocities are reported for peridotite, dunite, partially serpentinized dunite and peridotite, and serpentinite at hydrostatic pressures to 10 kb. Relationships between velocity and mineralogy are reported. Young's modulus, Lamé's constant, bulk modulus, and shear modulus of peridotites and dunites decrease rapidly with serpentinization. The effect of olivine orientation is found to account for compressional wave anisotropy; high velocities correspond to propagation parallel to maximum concentrations of olivine *a* axes, low velocities to propagation parallel to maximum concentrations of *b* axes.—D.B.V.

9887 **Chubb, L. J.** Rudists as index fossils, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 167–171, illus., 1966.

Benthonic fossils are generally regarded as unsuitable for horizon markers, but locally they have been used successfully. It is suggested that rudist pelecypods can be used for zoning the Cretaceous of the West Indies, and occasionally for correlation with Europe and north Africa. The lowest Cretaceous limestone in Jamaica is characterized by a simple rudist belonging to *Monopleura*, and a higher limestone yields *Pachytraga*, previously known only in the Mediterranean. Primitive rudists and members of the Caprotinidae, Caprinidae, Radiolitidae, and

Hippuritidae that occur in the West Indies and sometimes in Europe and Africa are described. The recent discovery of *Barrettia* in association with *Titanosarcolites* in St. Croix, seems to indicate passage beds between the Campanian and Maestrichtian.—E.S.L.

9690 **Church, Horace K.** Exploring excavation by seismic studies in southwestern U.S.: Roads and Streets, v. 109, no. 10, p. 60–63, 84–85, illus., tables, 1966.

Before excavations are made in the southwestern United States, uphole seismic studies are carried out at appropriate elevations in drill holes for which rock types, bedding planes, and the like have been carefully noted. Excavation methods are then recorded in detail and, at the end, the contractor has a complete analysis of the relation between these and the nature and stratigraphy of the rock. Examples are given for quarrying for rock fill, grading home sites, and distinguishing members of the Puente Formation of California. Seismic studies are believed to be preferable to exploratory drilling, unless the two methods can be combined.—E.S.L.

Cilweck, Blase A. *See* Slosson, James E. 9581

9673 **Clark, Kenneth F.** Structural control on intrusion, alteration, and ore deposition in the Red River district, New Mexico [abs.]: Econ. Geology, v. 61, no. 8, p. 1470, 1966.

9508 **Clayton, R. Hugh.** A ground survey at Strathcona Sound, N.W.T., *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 142–150, illus., 1966.

A number of small sulfide outcrops occur in this area in a thick formation of massive dolomite. The purpose of the survey was to find out which, if any, of these outcrops extended into the dolomite and to locate such extensions for a future drilling program. There were problems caused by the unusually low conductivity of the sulfides, probably due to the permafrost, and by the mountainous terrain which usually resulted in a rapid increase in overburden away from the outcrop. Magnetometer and horizontal-loop electromagnetic surveys gave little or no information but a high-frequency vertical-loop survey led to the delineation of a conductor over 2,000 feet in length. Subsequent drilling proved it to be a massive sulfide body containing zinc, lead, and silver in economic quantities.—Author's abstract

Cleary, William W. *See* Doyle, Larry J. 9647

9593 **Clemens, William A., Jr.** Fossil mammals of the type Lance Formation, Wyoming—Pt. 2, Marsupialia: California Univ. Pubs. Geol. Sci., v. 62, 122 p., illus., 1966.

Part 1 of this series, discussing general geology and the fossil multituberculates, was published in 1964. Part 3, when published, will discuss the eutherian fossils. The present part describes 10 species of four genera of marsupials known from the Late Cretaceous Lance local fauna; one genus (and subfamily of the Didelphidae) and six species are new. The North American marsupials were much more abundant and diverse in the Late Cretaceous than in the Tertiary; only the didelphines survived from the Mesozoic. On two island continents, however, South America and Australia, the marsupials of the Tertiary were as abundant and diverse as during the Late Cretaceous.—C.A.R.

9841 **Clyma, Wayne; Lotspeich, F. B.** Water resources in the High Plains of Texas and New Mexico: U.S. Agr. Research Service [Rept.] ARS 41-114, 14 p., illus., tables, 1966.

The High Plains area of Texas and New Mexico, in a youthful stage of the geomorphic cycle, is virtually untouched by erosion except on its margins. The Ogallala Formation, which supplies most of the ground water, is isolated from the Rocky Mts. to the west by the Pecos and Canadian Valleys, thus making recharge from the mountains impossible. Hydraulic properties of the Ogallala appear to vary from place to place. Recharge is slow under the present semiarid climate,

and assuming there is no pumping, should refill the aquifer to prior level if given enough time. Approximately 450 million acre-feet of water were available from storage as of 1958, but these supplies are being depleted faster than they are replenished through natural recharge.—M.C.M.

9814 **Colbert, Edwin H.** Ancient reptile of Blue Bell: Frontiers, v. 31, no. 2, p. 42–44, illus., 1966.

In the summer of 1942, a quarryman working with slabs of Triassic shale in a quarry near Blue Bell, Pa., noticed a jaw in the rock. It was turned over to the Academy of Natural Sciences of Philadelphia and was identified as the jaw of a phytosaurian reptile, *Rutiodon*. The phytosaurs and their environment are described and the question raised as to why they became extinct whereas the associated ancestral crocodile became the progenitor of a long line of evolution.—E.S.L.

0051 **Collins, A. Gene.** Emission spectrometric determination of barium, boron, iron, manganese, and strontium in oilfield waters using a plasma arc: Appl. Spectroscopy, v. 21, no. 1, p. 16–19, illus., tables, 1967.

Studies of the concentration and distribution of the mineral content in subsurface oilfield waters aid in locating water-pollution sources, determining water compatibilities, determining the origin and distribution of oilfield waters and petroleum, and exploring for petroleum and other minerals. An emission-spectrographic method using a plasma arc to determine B, Ba, Fe, Mn, and Sr in oilfield waters was developed. Variations in brine composition were reduced by use of a synthetic brine solution. Less than 1 mg/liter of each ion can be detected. Synthetic and natural oilfield waters containing the subject ions were mixed with various organic solvents and the internal standard. Relative intensities of their emission lines were determined using each of 10 solvent systems.—Author's abstract

Collins, Kenneth A. *See* Haskin, Larry A. 9815

9834 **Colombo, Giuseppe; Lautman, Don A.; Shapiro, Irwin I.** The Earth's dust belt, fact or fiction?—[Pt.] 2, Gravitational focusing and Jacobi capture: Jour. Geophys. Research, v. 71, no. 23, p. 5705–5717, illus., 1966.

Reassessment of the effectiveness of the gravitational attraction of the Earth in increasing the near-Earth dust concentration over its interplanetary value shows that for a realistic distribution of dust-particle speeds at the boundary of the Earth's sphere of influence, the enhancement is negligible. The restricted three-body problem, including sunlight pressure, is also analyzed. Results indicate that the Jacobi capture of dust particles into temporary orbits is so rare that its effect on the near-earth dust concentration may be neglected.—D.B.V.

Colombo, Giuseppe. *See* Shapiro, Irwin I. 9838

9839 **Colombo, Giuseppe; Shapiro, Irwin I.; Lautman, Don A.** The Earth's dust belt, fact or fiction?—[Pt.] 3, Lunar ejecta: Jour. Geophys. Research, v. 71, no. 23, p. 5719–5731, illus., tables, 1966.

We have studied in considerable detail the orbits of small dust particles ejected from the lunar surface during meteorite-Moon collisions. Only a small percentage enter into geocentric orbits; of these, almost none remains in such an orbit for more than one year. Using an upper-bound estimate on the amount of dust that the Moon might supply to cislunar space, we conclude that lunar ejecta do not cause an appreciable enhancement of the near-Earth dust concentration.—Authors' abstract

Colombo, Giuseppe. *See* Lautman, Don A. 9840

Compston, W. *See* McIntyre, G. A. 9737

9683 **Compton, Robert R.** Analyses of Pliocene-Pleistocene deformation and stresses in northern Santa Lucia Range, California: Geol. Soc. America Bull., v. 77, no. 12, p. 1361–1379, illus., 1966.

Folds and reverse faults that formed during the Pliocene–Pleistocene orogeny in the northern Santa Lucia Range trend roughly parallel to basement foliations, which are older than latest Cretaceous. Groove directions measured on 1500 minor faults are roughly accordant to petrofabric compression axes determined from calcite lamellae in 19 marbles and 26 sandstones. The average of the σ_1 orientations in the basement is a line plunging 30° N. 30° E. The basement rocks of the range were shortened about 12 percent in a direction roughly normal to the N. 40° W. trend of the range and caused the upper part of the sedimentary sequence to buckle more or less independently of the basement, thus forming disharmonic folds high in the section. The range was probably produced by deep-seated deformation, possibly a northeast-to-southwest flowage under the crust.—H.C.W.

9490 **Conlon, Robert J.** Landslide on the Toulnustouc River, Quebec [with French abs.]: Canadian Geotech. Jour., v. 3, no. 3, p. 113–144, illus., tables, 1966.

The Toulnustouc landslide, which involved 5,000,000 cu yd of extra-sensitive, fine-grained estuarine sediments, demonstrates a mechanism of progressive failure. The propagation of a failure surface and the development of the failure scarp occurred while the mass remained intact. The high strength of the sediments with natural undrained shear strength values of 8,000 lb/sq ft together with remolded consistency of a viscous liquid, offered an opportunity to study the mechanical behavior of the structure of a sensitive soil. A concept of an "open, cementation-bonded structure" is developed from laboratory test results. It is believed that thic concept of soil structure may be applicable to all sensitive Canadian marine and estuarine clays.—B.S.H.

9544 **Cook, Harry Edgar, 3d.** Geology of the southern part of the Hot Creek Range, Nevada [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1510B, 1966.

9819 **Cook, John C.** The seismometer as a hydrophone: Seismol. Soc. America Bull., v. 56, no. 5, p. 1177–1184, illus., 1966.

Results are presented briefly of preliminary studies and experiments in a swimming pool, to explore the idea of using a submerged seismometer as an underwater sound sensor ("inertial hydrophone"). It consists of a sealed, buoyant, horizontal inertial seismometer anchored to the bottom by chains or cables.—D.B.V.

9885 **Cooke, D. L.; Bailey, B. V.** Marble at Mt. Hibernia, Jamaica, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 123–128, illus., table, 1966.

The marble deposit occurring along the south slope of the Blue Mountain Range and part of a belt extending for 18 miles, is metamorphosed Cretaceous limestone associated with the Clydesdale–Plantain Garden thrust. An estimated volume of 270,000 cu yd may be extracted by ordinary quarrying methods. The marble is white to gray in color, but contains laminated sections of green, maroon, and white; it is fine-grained and takes a high polish. A geologic sketch map is included.—E.S.L.

Corbató, C. E. *See* Harrison, J. C. 9498

9618 **Correa Pérez, Genaro.** Estudio geológico económico de la cuenca del Río Parián de Tomellín a Parián, La Carbonera y la zona pegmatítica de Telixtlahuaca en el estado de Oaxaca, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 2: México, D. F., Soc. Mexicana Geografía y Estadística, p. 760–781, illus., 1966.

Investigations of this region since 1880 are reviewed with very brief summation of results. Predominantly metamorphic gneisses generally agreed to be Precambrian, are cut by pegmatites of different shapes and composition, the origins of which have been disputed. Younger formations are Mesozoic and Tertiary clastic and volcanic rocks and thick Quaternary deposits. Important mineral deposits present to the south of Tomellín a Parián include biotite mica sheets 20 cm in length. Graphite, once in good production, is an important resource for the future. Various metallic deposits and radioactive minerals are associated with the pegmatites. Sketch

maps show distribution of principal rocks and various mineral deposits and mines.—G.D.C.

9711 **Cotter, R. D.; Bidwell, L. E.** Water resources of the Pomme de Terre River watershed, west-central Minnesota: U.S. Geol. Survey Hydrol. Inv. Atlas HA-220, 4 sheets, scale 1:250,000, 1966.

Sheet 1 contains block diagrams of the Pomme de Terre watershed, diagrams and graphs of the water budget, tables of municipal supply potential and water use, and a summary of the relative adequacy of water sources. Ground water is available everywhere but aquifers yielding several hundred gpm are confined largely to the outwash valley of the river and ice-contact deposits in the north; Cretaceous and Precambrian bedrock are poor aquifers. Water is suitable for most purposes. Sheet 2 deals with surface water, sheet 3 with chemical quality of water, and sheet 4 with ground water. The piezometric map shows that ground-water flow is from NE to SW in the northern part of the watershed and generally south in the southern part.—M.C.M.

Couch, R. W. *See* Dehlinger, Peter. 9929

9604 **Crain, E. R.; Anderson, W. B.** Quantitative log evaluation of the Prairie Evaporite formation in Saskatchewan: Jour. Canadian Petroleum Technology, v. 5, no. 3, p. 145-152, 1966.

Solving for the fraction of sylvite, carnallite, halite, and insoluble material in the Prairie Evaporite Formation can be performed by a suitable interpretation program based upon γ-ray, sonic, neutron, and caliper logs. Empirical relations were established between the log values and the formation parameters.—W.R.A.

Crandell, Dwight R. *See* Easterbrook, Donald J. 0013

9743 **Crawford, C. B.** Resistance of soil structure to consolidation [reply to discussion following original paper, 1965]: Canadian Geotech. Jour., v. 3, no. 2, p. 98-100, 1966.

An attempt is made to explain some apparent contradictions between results of standard consolidation tests on an undisturbed sensitive clay soil (Leda clay) given in the original paper (ibid., v. 2, no. 2, p. 90-97, 1965), and previously published and independent results of tests on similar soils, as brought out in the group discussion (ibid., v. 2, no. 2, p. 98-115, 1965). The author concludes that further research on deformation of natural clays under known effective stresses at various rates of application is required to reveal the appropriate values for actual cases.—V.M.J.

9790 **Crawford, Thomas J.; Hurst, Vernon J.; Ramspott, L. D.** Extrusive volcanic rocks and associated dike swarms in central-east Georgia—Geol. Soc. America, Southeastern Sec., Field Trip 2, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 53 p., illus., table, 1966.

The guidebook consists of a paper and road log, most of the information in which is new. Basalts, dacites, and a variety of others comprise the pre-Mesozoic volcanic rocks, all regionally metamorphosed at the close of the Paleozoic. Triassic diabase dikes have not been metamorphosed. Upper Cretaceous or lower Tertiary tuffs and other pyroclastics form a 12-28 ft layer at the top of the Tuscaloosa Formation. All units are described, and photomicrographs are included in the road log. A description of the flint kaolin is given at Stop 7, and the stratigraphic sequence at an abandoned kaolin mine (Stop 8) is shown in a table and diagrams.—E.S.L.

Crawford, Thomas J. *See* Sandy, John. 9831

9509 **Crone, J. Duncan.** The development of a new ground EM method for use as a reconnaissance tool, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 151-156, illus., 1966.

In the shootback electromagnetic method, each of two coils is used to transmit and receive in sequence. Dip angles are measured in the vertical plane passing through the axes of the coils. The coils, when operating, are tilted 15 degrees from a coaxial alignment. The sum of the two dip angles obtained at each recording interval contains no significant errors due to accidental misalignment of coils. The response of the system to sulfide ore bodies is satisfactory as illustrated by examples, while the response to such extraneous features as faults, shears, conductive overburden, etc., is minimized by the system geometry. The light weight and versatility of the JEM [Junior Electromagnetic] system render it of value in general reconnaissance, airborne anomaly follow-up and evaluation of outcropping prospects.—*from* Author's abstract

9518 **Crusafont-Pairó, M.; Truyols Santonja, J.** Masterometry and evolution again [translated from Spanish by G. G. Simpson; reply to "A review of masterometry" by G. G. Simpson, 1965]: Evolution, v. 20, no. 2, p. 204–210, 1966.

Simpson (ibid., v. 19, no. 2, p. 249–255, 1965) has reviewed the authors' work (published in Spain, 1953–59) on masterometry, biometric methods applied to evolution of dentition of fissiped carnivores. Three basic facts were not taken into account by Simpson: (1) *Cynodictis* (Eocene) was chosen as a basal type for the fissipeds even before results were known. (2) Significant but simple dentition characters were chosen so as to have a bipolar distribution in the course of evolution of the group. (3) In the values for both methods, the regression line obtained for the sum total of the forms, treated as a population, passed through the point representing the values for *Cynodictis*. The methods should be used complementally, not separately. Crusafont-Pairó attempts here and in later papers (1962–65) to reconcile the synthetic theory of evolution with orthogenesis.—V.M.J.

9677 **Culbertson, William C.** Trona in the Green River basin of Wyoming [abs.]: Econ. Geology, v. 61, no. 8, p. 1471, 1966.

Culver, Lewis G. *See* Foster, Roy W. 9622

9611 **Currie, K. L.** Geology of the New Quebec crater [with French abs.]: Canada Geol. Survey Bull. 150, 36 p., illus.; table, geol. map, 1966.

The New Quebec Crater is a circular depression in the acid Archaean gneisses of northern Quebec, about 2 miles in diameter and 1,300 feet deep. The regional structure is a complex series of north-trending isoclinal folds cut by four systems of faults. The elevated crater rim shows deflection of curvi-planar structure elements, demonstrating that a dome previously existed over the crater. Significant hydrothermal alteration occurs in the wall of the crater but not elsewhere in the region. There is no evidence that the shape of the crater has been substantially modified by erosion. No evidence of meteorite impact or of catastrophic violent origin was found. The evidence is quantitatively consistent with an origin by collapse of a fluid-supported dome. Time of origin of the crater is thought to be late Pleistocene.—Author's abstract

9714 **Custer, Richard L. P.** Paleocurrents of the Triassic Durham basin, North Carolina [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 82, no. 2, p. 94, 1966.

9491 **Cvancara, Alan M.** Revision of the fauna of the Cannonball Formation (Paleocene) of North and South Dakota—Pt. 1, Bivalvia: Michigan Univ. Mus. Paleontology Contr., v. 20, no. 10, p. 277–374, illus., tables, 1966.

Thirty species of bivalves [Pelecypoda] are recognized from the Cannonball Formation (Paleocene) of the Dakotas [115 localities in western North Dakota]. One species is considered new, *Caestocorbula sinistrirostella* sp. nov. Approximately 40 percent of the bivalves indicate a post-Cretaceous or Paleocene age. Seemingly, few similarities exist between the bivalve fauna of the Cannonball Formation and that of the Midway Group (Paleocene) of the American Gulf Coast. Several Cannonball bivalves show closer similarities with those of northern Europe (London and Paris basins), and suggest a Thanetian age.—Author's abstract

Dalquest, Walter W. *See* Hibbard, Claude W. 9479

9606 **Daniels, R. B.; Gamble, E. E.; Wheeler, W. H.; Nettleton, W. D.** Coastal plain stratigraphy and geomorphology near Benson, North Carolina: Southeastern Geology, v. 7, no. 4, p. 159–182, illus., table, 1966.

"High-level" sediments in the Benson, N. C., area, are divided into the Miocene Macks Formation, Pliocene Pinehurst Formation, and "Brandywine Formation." The Macks is a uniform, silty fine sand and the Pinehurst a medium to coarse sand and clay, separated from the Macks by an erosional contact. Topographic features at the boundary must be used to separate the Pinehurst and "Brandywine" Formations; small depressions (Carolina Bays) commonly mark the contact, and there is a distinct flattening of slope. An erosion surface at the base of the "Brandywine" truncates the Macks and Pinehurst. The surface is not everywhere buried by the "Brandywine" and its subaerial portion is mapped as the Coats scarp (Pliocene or Pleistocene) believed to be correlative with the Orangeburg scarp in South Carolina which is regarded as a Miocene sea cliff.—B.S.H.

0056 **Davies, Gordon L.** George Hoggart Toulmin and the Huttonian theory of the Earth: Geol. Soc. America Bull., v. 78, no. 1, p. 121–123, 1967.

Contrary to recent suggestions that Hutton was indebted to the work of Toulmin, contemporary sources indicate that Hutton formulated his theory more than a decade before publication of Toulmin's book. Textual similarities may indicate plagiarism from Hutton's work while Toulmin was a student at Edinburgh.—J.J.H.

9699 **Davies, J. C.; Pryslak, A. P.** (compilers). Lower English River sheet, District of Kenora: Ontario Dept. Mines Prelim. Geol. Map P. 366, scale 1 in. to 2 mi., 1966.

9545 **Davis, William Edwin, Jr.** Conodont fauna of the Tully Limestone, Middle Devonian, New York state [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1510B–1511B, 1966.

9608 **Dawson, K. R.** Geology, Preissac–Lacorne batholith, Quebec: Canada Geol. Survey Map 1179A (also in Bull. 142), scale 1:63,360, 1966.

9652 **Dawson, K. R.** A comprehensive study of the Preissac–Lacorne batholith, Abitibi county, Quebec [with French abs.]: Canada Geol. Survey Bull. 142, 76 p., illus., tables, geol. map, 1966.

The Archean Preissac–Lacorne batholith intrudes Archean sedimentary and volcanic rocks and is cut by Proterozoic gabbro dikes near the south side of the Superior structural province. The rocks range from intermediate monzonite and syenodiorite to granodiorite and leucoadamellite with associated acidic dikes. The chemically and mineralogically homogeneous leucoadamellite was derived from a granodiorite magma by crystallization differentiation. The intermediate facies, which are mineralogically and chemically heterogeneous and contain numerous xenoliths, are attributed to contamination of the magma by wall rock materials. Gravimetric and magnetic data indicate that the batholith is a continuous body at shallow depth with a total thickness of 16,000 feet. Potassium–argon ages for the micas of the granitic rocks fall in the range between 2,300 m.y. and 2,800 m.y. Geologic and magnetic maps are included.—B.S.H.

9929 **Dehlinger, Peter; Gemperle, Michael; Couch, R. W.** Free-air gravity anomalies along the Inside Passage of British Columbia and Alaska: Jour. Geophys. Research, v. 71, no. 24, p. 6011–6015, illus., table, 1966.

Continuous measurements were made with a LaCoste–Romberg surface-ship gravimeter along canals, bays, channels, and fiords between Skagway and Seattle. Free-air anomalies calculated along the traverses, usually at 1.5-km intervals, are between +25 and −165 mgal. Uncertainty in the measurements was ±2 mgal. In general, the free-air anomalies are small near the coast and become progressively more negative inland along the fiords. Most of the large negative anomalies north of Vancouver Island are caused by the rugged terrain, whereas to the southeast

in Puget Sound most are essentially of geologic origin. A map of the track lines and approximate free-air anomalies is presented.—D.B.V.

9933 **Deju, R. A.; Bhappu, R. B.** A chemical interpretation of surface phenomena in silicate minerals: Soc. Mining Engineers Trans., v. 235, no. 4, p. 329–332, illus., tables, 1966.

Further information on the surface characteristics of the silicate minerals was obtained by experimentally correlating the oxygen–silicon ratio of the silicates with their electrokinetic properties. Specifically, the behavior of the minerals in an electric field was investigated using zero point of charge as a parameter. A modified electrophoresis cell was used for the determination of electrophoretic mobilities. It was shown that there is an increase in the zero point of charge with increasing oxygen–silicon ratio in the silicates. Finally, a chemical interpretation was presented to describe the surface phenomena [adsorptive behavior] observed in the experiments. [The chemical equations postulate that the reaction between the silicate mineral particles and water involves mainly an exchange of metal ions for hydrogen].—Authors' abstract

9662 **Delaney, J. R.; Henika, W. S.; Christensen, J.** Delineation and interpretation of the St. Stephens Church magnetic anomaly, King and Queen County, Virginia [abs.], *in* Virginia Acad. Sci. Proc. 1965–66: Virginia Jour. Sci., new ser., v. 17, no. 4, p. 317, 1966.

Dellwig, L. F. *See* Moore, R. K. 9706

DeLong, S. E. *See* Powell, J. L. 9480

Denison, Rodger E. *See* Muehlberger, William R. 9736

0057 **Dennen, W. H.** Trace elements in quartz as indicators of provenance: Geol. Soc. America Bull., v. 78, no. 1, p. 125–130, illus., tables, 1967.

Trace elements in quartz provide a means of correlating detrital grains with their source rock. A test on quartz from the Red Beach granite and sedimentary rocks of the Perry Formation of southeastern Maine shows the granite to be the source of the sedimentary rocks.—J.J.H.

Desai, Arvind A. *See* Hagni, Richard D. 9686

Dexter, D. *See* Menzies, R. J. 9906

9898 **Diamond, Sidney.** The fabric of anisotropically consolidated sensitive marine clay [discussion of paper by R. M. Quigley and C. D. Thompson, 1966]: Canadian Geotech. Jour., v. 3, no. 4, p. 242–249, illus., table, 1966.

The writer has found that oriented specimens of Leda clay produce peak heights more than 25 times as large as those obtained in random orientation mount. This suggests that the three-fold increase found by Quigley and Thompson (ibid., v. 3, no. 2, p. 61–73, 1966) on remolding and consolidation represents only a limited degree of particle rearrangement.—E.S.L.

9546 **Dickinson, Robert Gerald.** Geology of the Cerro Summit quadrangle, Montrose County, Colorado [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1511B, 1966.

9734 **Dillon, Howard B.; Andersland, O. B.** Predicting unfrozen water contents in frozen soils [with French abs.]: Canadian Geotech. Jour., v. 3, no. 2, p. 53–60, illus., tables, 1966.

A relationship between temperature and certain soil properties including specific surface area, activity ratio, and the expandable clay lattice, is presented for predicting the unfrozen water content of frozen soils. Data on experimental calorimetric determinations for ice content of two frozen clays and a frozen silty clay are given. Predicted unfrozen water contents are compared with experimental values for eleven

soils with good agreement in all cases. Temperatures close to and above the freezing point depression of the soil are excluded. Knowledge of the unfrozen water content in frozen soils permits a more realistic approach to a variety of problems in frozen soil mechanics.—Authors' abstract

9759 **Dix, C. Hewitt.** Seismic prospecting, *in* Methods and techniques in geophysics, V. 2: London and New York, Interscience Publishers, p. 249–278, illus., 1966.

Seismic prospecting uses seismic waves and their reflection, refraction, and scattering properties, stimulated by artificial explosions or mechanical power devices, for the determination of geological structure. Natural earthquake waves have not been used extensively, mostly because the techniques have not been developed extensively. Seismic reflection methods, mathematical theory of reflection interpretation, measurement of velocities, seismic refraction prospecting, and fan refraction shooting are examined. Brief mention is made of the so-called 'phase-velocity' method of prospecting which is of value when coupled with ordinary refraction work in areas where reflection work is difficult or impossible. A list of 31 references is included.—V.S.N.

9806 **Doberenz, Alexander R.; Matter, Philip, 3d; Wyckoff, Ralph W. G.** The microcomposition of some fossil insects of Miocene age: Southern California Acad. Sci. Bull., v. 65, no. 4, p. 229–236, illus., 1966.

The microcomposition of fossil insects from petroliferous nodules of Miocene age from ancient fresh water lake beds in the Calico Mountains, San Bernardino County, Calif., has been determined by employing techniques of electron microscopy, electron-probe analysis, and microradiography. Because these insects are very well preserved, it has been possible to take microradiographs showing internal structure of both body segments and head. With the electron probe the principal elements were found to be strontium and sulfur together with small amounts of silicon. By measuring the S/Sr ratio and verifying with X-ray diffraction, it is concluded that most insects examined are pure celestite. X-ray diffraction patterns using intact fossils show that most are composed of a few large well-oriented crystals.—M.S.T.

Dolan, W. M. *See* Brant, A. A. 9507

9864 **Donnay, Gabrielle; Thorpe, A. N.; Senftle, Frank E.; Sioda, R.** Absence of neutral alkali atoms in rhodizite: Science, v. 154, no. 3751, p. 889–890, illus., 1966.

The formula $CsB_{12}Be_4Al_4O_{28}$ has been proposed by others for the mineral rhodizite. Electron spin-resonance and magnetic susceptibility measurements prove the absence of neutral cesium atoms. An ionic formula $CsB_{11}Be_4Al_4O_{26}(OH)_2$ is proposed.—Authors' abstract

9869 **Donnelly, Thomas W.** Tectonic significance of the spilite-keratophyre association, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 12–26, illus., 1966.

A literature review indicates that there is a marked tendency for the association spilite-keratophyre to appear at the beginning of tectonic cycles. This association is commonly replaced by andesite-dacite at a later period in the cycle. Petrographic and chemical criteria which will set off these rocks from other volcanic rocks can be used to delimit volcanic rocks that belong to different tectonic stages, or to identify these rocks in the highly metamorphosed mountain cores. Spilite-keratophyre sections in the Cretaceous of the Virgin Islands and the Ordovician of Wales are compared. Other associations in North America and other continents except Africa are described briefly. These rocks originated from a hydrous magma; problems of emplacement and origin are discussed.—E.S.L.

9777 **Dooley, J. R., Jr.; Granger, H. C.; Rosholt, J. N.** Uranium-234 fractionation in the sandstone-type uranium deposits of the Ambrosia Lake district, New Mexico: Econ. Geology, v. 61, no. 8, p. 1362–1382, illus., tables, 1966.

Preferential extraction of daughter U-234, in an oxidized state because of the disintegration mechanism, has lead to significant fractionation of U-234 and parent

U-238. Migration and redeposition causes enrichment in U-234 near the top of ore layers and depletion in the richer ore of the center. The bottoms of ore layers are enriched where they lie above the water table. Significant redistribution of uranium has occurred during the last 200,000 years.—W.S.W.

Doss, A. K. *See* Spiva, Frank, 0081

9647 **Doyle, Larry J.; Cleary, William W.** Distribution of mica on the continental shelf, beaches, and rivers of the southeastern United States [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 82, no. 2, p. 94, 1966.

9623 **Drahovzal, James Alan.** Upper Mississippian (Visean-Namurian) ammonoids of northern Arkansas [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1511B-1512B, 1966.

9940 **Dresch, Jean.** Observaciones sobre las regiones áridas de América del Sur y de los Estados Unidos—Ensayo de comparación, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 190-199, 1966.

The distribution of arid regions in the United States is compared with those of South America, particularly those near the western border of both continents. Differences in elevation of ranges are noted with relation to latitudes and climates, glacier cover, and pediment character. Their evolution is discussed as affected by paleoclimatic changes of the Quaternary Period, as well as glacial, interglacial, and postglacial tectonic activity, erosion and deposition.—G.D.C.

9691 **Driscoll, Egbert G.** Morphology and evolution of certain Paleozoic Nuculanidae from the midcontinental United States: [Czechoslovakia] Národ. Muz. Praze Sborník, ser. B, v. 22, no. 1, p. 1-26, illus., tables, 1966.

Certain pelecypods of the family Nuculanidae, abundant in upper Paleozoic, especially Pennsylvanian, strata of midcontinental U.S., have previously been given the names *Leda, Nuculana, or Culunana bellistriata, Nucula arata, Leda pandoraeformis*, and others. 249 specimens are reexamined, with aid of statistical analysis using five measurements, and redescribed as *Polidevcia pandoraeformis* (Mississippian, Mich.), *P. bellistriata* (Pennsylvanian-Lower Permian), and *P. arata* (Middle Pennsylvanian), and *Phestia ginnyi*, n. sp. (Lower Permian, Wyo.). Relative height-length growth lines show substantial differences between *Phestia and Polidevcia*. Significant evolutionary trends in *Polidevcia* are: reduction of umbonal ridge, strengthening of principal internal ridge, reduction in number of concentric ribs.—V.M.J.

0078 **Dunlap, William H.** Chaveroo revisited [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 167, 1967.

9894 **Durham, J. Wyatt; Fell, H. B.; Fischer, A. G.; Kier, P. M.; Melville, R. V.; Pawson, D. L.; Wagner, Carol D.** Echinoids, *in* Treatise on invertebrate paleontology—Pt. U, Echinodermata 3, V. 1-2: New York, Geol. Soc. America (and Univ. Kansas Press), V. 1, p. U211-U366a, illus., table, 1966; V. 2, p. U367-U640, illus., table, 1966.

Echinoidea are free-living echinozoans with pentameral subspherical or modified subspherical test built of interlocking calcareous plates bearing movable appendages (spines, etc.); the oral surface rests on the substrate. This large class (768 genera), ranges from Ordovician to Recent. Echinoids fall into two main morphological groups, formerly considered subclasses, regular (radial symmetry predominant, anus within apical system) and irregular (bilateral symmetry predominant, anus outside apical system); irregular echinoids are now considered polyphyletic. In the Treatise, four orders of primitive regular echinoids are placed in the subclass Perischoechinoidea, the rest in Euechinoidea. Anatomy of living forms, skeletal morphology, ecology and paleoecology, evolution, and classification systems are discussed in separate sections.—V.M.J.

9896 **Durham, J. Wyatt.** (and others). Treatise on invertebrate paleontology—Pt. U, Echinodermata 3, Asterozoa, Echinozoa, V. 1–2: New York, Geol. Soc. America (and Univ. Kansas Press), V. 1, p. U1–U366a, illus., tables, 1966; V. 2, p. U367–U695, illus., table, 1966.

Taxonomy of the subphyla Asterozoa and Echinozoa of the phylum Echinodermata is treated (subphyla Homalozoa and Crinozoa will be treated in Pts. S and T), with systematic descriptions to the generic level for fossil and living forms; complete nomenclature is given, with references, and type species (and additional fossil species) are figured. Nine major divisions are cited separately: asterozoans; general features and relationships of echinozoans; homology of echinozoan rays; (the following six classes of echinozoans) helicoplacoids; edrioasteroids; ophiocistioids; cyclocystoids; echinoids; holothurians. Senior authors of the divisions are, respectively: W. K. Spencer, H. B. Fell, R. C. Moore, J. W. Durham, G. Regnéll, G. Ubaghs, R. V. Kesling, J. W. Durham, D. L. Frizzell.—V.M.J.

9910 **Durham, J. Wyatt; Caster, Kenneth E.** Helicoplacoids, *in* Treatise on invertebrate paleontology—Pt. U, Echinodermata 3, V. 1: New York, Geol. Soc. America (and Univ. Kansas Press), p. U131–U136, illus., 1966.

The echinozoan class Helicoplacoidea is confined to the Lower Cambrian, and is represented by but one genus, *Helicoplacus*. These are free-living fusiform (when expanded) to pyriform (when contracted), with spirally pleated flexible test, apical and oral poles at opposite extremities, columns of ambulacral and interambulacral plates disposed spirally, the plates originating at the apical pole. The helicoplacoids apparently left no descendants: the imbrication of the test in the retracted state, however, suggests relation to edrioasteroids. Also, it is suggested that the holothurians, and early echinoids such as the lepidocentrids, may have been derived from the immediate, pretorsion ancestor of the helicoplacoids.—V.M.J.

9571 **Dymond, Jack Roland.** Potassium-argon geochronology of deep-sea sedimentary materials [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1558B, 1966.

0013 **Easterbrook, Donald J.; Crandell, Dwight R.; Leopold, Estella B.** Pre-Olympia Pleistocene stratigraphy and chronology in the central Puget Lowland, Washington: Geol. Soc. America Bull., v. 78, no. 1, p. 13–20, illus., tables, 1967.

Drifts of two pre-Olympia glaciations separated by nonglacial sediments are widespread in the central Puget Lowland of western Washington. The Double Bluff Drift (older) and Possession Drift represent advances of the Puget lobe of the Cordilleran ice sheet more than 40,000 years ago. The nonglacial Whidbey Formation between the drifts was formed in streams and lakes. During its deposition, climate was initially cool and moist, as inferred from pollen in peat beds, but subsequently it became much like that of the present in the lowland. The Possession Drift is tentatively correlated with glacial deposits of Salmon Springs age in the southern part of the lowland. The Whidbey Formation may correlate with nonglacial deposits between two Salmon Springs Drifts or with the Puyallup Formation.—Authors' abstract

Ediger, N. M. *See* Burke, C. F., Jr. 9787

Eisler, J. D. *See* Chilton, Frank. 9816

9494 **Elias, Maxim K.** Late Paleozoic conodonts from the Ouachita and Arbuckle Mountains of Oklahoma: Oklahoma Geol. Survey Guide Book 16, 39 p., illus., 1966.

Two species of the conodont subgenus *Gnathodus (Harltonodus)* and two species and a subspecies of *Neoprioniodus* from the Mississippian of Oklahoma, originally described by Elias in 1959 are here more completely described and discussed in light of later publications. The 1959 illustrations, in part redrawn, are arranged

in stratigraphic order, which is correlated with the standard zones of western Europe. Three new subspecies and species are introduced here: *Gnathodus (Harltonodus) delicatus hassi, Neoprioniodus erectus rexroadi, N. higginsi.* The concepts of other species and subspecies of the above genera, and of *Hindeodelloides, H. bicristatus, and Ligonodina* are discussed and/or emended.—V.M.J.

Elliot, C. L. *See* Brant, A. A. 9507

9665 **Ellison, Samuel P., Jr.** Memorial to Maurice Goldsmith Mehl (1887–1966): Geol. Soc. America Bull., v. 77, no. 12, p. P219–P224, portrait, 1966.

9481 **Emiliani, Cesare.** Isotopic paleotemperatures: Science, v. 154, no. 3751, p. 851–857, illus., table, 1966.

Urey's method (1947) of determining the temperature at which carbonate was deposited from its oxygen isotopic composition has contributed greatly to knowledge of past climates. Some results of its application are reviewed here under the headings: analysis of fossil shells; analysis of deep-sea cores; glacial, interglacial, and nonglacial sea water; correlation of the oceanic and continental records; and causes of glaciation.—D.B.V.

9495 **Emlong, Douglas R.** A new archaic cetacean from the Oligocene of northwest Oregon: Oregon Univ. Mus. Nat. History Bull. 3, 51 p., illus., tables, 1966.

A cetacean skeleton, *Aetiocetus cotylalveus* n. gen. n. sp., discovered in the upper Oligocene Yaquina Formation of coastal Lincoln County, Oreg., has so many distinctive features that a new family, Aetiocetidae, is proposed for it. Although *Aetiocetus* has functional teeth and bears some resemblance to members of the primitive odontocete families Agorophiidae, Patriocetidae, and Microzeuglodontidae, it differs from them in many major features. On the other hand, many features appear antecedent to those of members of the Mysticeti; except for presence of functional teeth in a mature specimen, *Aetiocetus* could be placed in this suborder. Because of several critical skull features showing archaeocete affinities not retained on any known odontocete skull, *Aetiocetus* is referred to the suborder Archaeoceti, and is considered a close antecedent to the Mysticeti.—V.M.J.

9610 **Emslie, R. F.; Holman, R. H. C.** The copper content of Canadian shield rocks, Red Lake–Lansdowne House area, northwestern Ontario [with French abs.]: Canada Geol. Survey Bull. 130, 31 p., illus., tables, 1966.

An experimental geochemical survey was made of copper in the common rocks of 43,000 sq mi of the Canadian Shield in the Province of Ontario. It was based on the analyses of 7,963 samples and has shown that, (1) the mean copper content of the main rock types varies from 7 ppm in leucocratic granites to 61 ppm in basic volcanic rocks (these mean concentrations are lower than most published abundance figures for copper in similar rocks); (2) variations in the mean copper content within each rock type, considered on a regional scale, are in general insignificantly small, but there are exceptions; and (3) the distribution of the copper in each rock type is approximately lognormal.—Authors' abstract

9520 **Engineering Geology.** Mark Sherwood Lyons (1927–1965): Eng. Geology, v. 3, nos. 1–2, p. 97–98, portrait, 1966.

9850 **Enjalbert, Henri.** Los rasgos originales del karst en las montañas y mesetas calcareas de México y de Guatemala, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 277–280, 1966.

Cretaceous limestones form immense, little disturbed plateaus in Guatemala and in Mexico between the Gulf coastal plain and the San Luis de Potosí region, where karst typical of a more or less humid tropical environment could evolve. But in the folded mountain ranges, elevated to heights of from 2,000 to 3,800 m by Tertiary tectonic movements, there are great canyons of rejuvenation and karst more like that of temperate climates. In Guerrero and Morelos are large caverns where underground river courses are choked with fluvial deposits of volcanic material.

In regions of high mountains, effects of glacial and periglacial phenomena are important.—G.D.C.

Epstein, Samuel. *See* O'Neil, James R. 9504

Epstein, Samuel. *See* Garlick, G. Donald. 9679

9533 **Ern, Ernest H.** Minor structures and axial surface deformation in east-central Vermont [abs.], *in* Virginia Acad. Sci. Proc. 1965–66: Virginia Jour. Sci., new ser., v. 17, no. 4, p. 317–318, 1966.

9630 **Estes, E. L.** Quartz grain roundness in the sediments of the southern United States Atlantic continental margin [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 82, no. 2, p. 93–94, 1966.

Everett, Duane E. *See* Rush, F. Eugene. 9842

9902 **Ewing, John; Worzel, J. Lamar; Ewing, Maurice; Windisch, Charles.** Age of horizon A and the oldest Atlantic sediments: Science, v. 154, no. 3753, p. 1125–1132, illus., 1966.

Recent surveys have defined an outcrop of horizon A in the North American basin, and sediment cores taken from the outcrop area have identified the reflective interface as the top of a turbidite sequence of Upper Cretaceous age. This finding supports earlier speculation that the horizon is a fossil abyssal plain; the moderate amount of distortion indicates that the major Atlantic basins have been relatively stable at least through most of Cenozoic time. The seismic data associated with horizon A and the outcrop area are presented here, and their pertinence to the questions of stability of the basins, possible age of the deepest sediments below horizon A (late Jurassic for horizon B, Cenomanian for horizon ?), and the geologic history of the oceans (rate of spreading) are discussed.—D.B.V.

Ewing, Maurice. *See* Ewing, John. 9902

Ewing, Maurice. *See* Langseth, Marcus G., Jr. 9925

Exline, Harriet. *See* Frizzell, Don L. 9913

9704 **Fabregat Guinchard, Francisco J.** Los minerales mexicanos—[Pt.] 3, Durangita: México Univ. Nac. Autónoma Inst. Geología Bol. 77, 113 p., illus., tables, 1966.

Mineral data on durangite are compiled from the literature and critically reviewed. Durangite is a fluoarsenate, $Na(Al,2Fe)[F,O \quad AsO_4]$, occurring as monoclinic holohedral crystals, discovered in 1869 in the tin placers of Durango, Mexico (type locality, Potrillos mine, Coneto–Sapiovis area). It is isotypic and probably isomorphous with titanite, tilasite, and cryophiolite, and is related to the orthorhombic isomorphous descloizite group. Detailed data on physical and optical properties of natural and synthetic crystals, chemical and X-ray analyses, crystal morphology, chemistry and structure, systematic position in the tilasite group, and mineral genesis are included.—V.M.J.

9705 **Fabregat Guinchard, Francisco J.** Los minerales mexicanos—[Pt.] 5, Livingstonita: México Univ. Nac. Autónoma Inst. Geología Bol. 79, 84 p., illus., tables, 1966.

Mineral data on livingstonite are compiled from the literature and critically reviewed. Livingstonite is an acidic sulfantimonite, $HgSb_4S_8$, monoclinic holohedral, discovered in 1874 in Guerrero, Mexico (type locality, La Cruz mercury–antimony mine, Huitzuco mining district). It is intimately associated with stibnite; the minerals are not isomorphous, though similar in appearance and aggregation. Detailed data on physical and optical properties, chemical and X-ray analyses, crystal morphology and structure, systematic position (provisional, according to several different classifications), mineral genesis, and paragenesis are included.—V.M.J.

9783 **Fabregat-Guinchard, Francisco J.** Los minerales mexicanos—[Pt.] 4, Cumengeíta (morfología): México Univ. Nac. Autónoma Inst. Geología Bol. 78, 67 p., illus., tables, 1966.

Mineral data on cumengéite are compiled from literature and critically reviewed. Cumengéite is a rare oxychloride, $PbCl_2 \cdot Cu(OH)_2 + H_2O$, tetragonal holohedral, first described in 1891 from the type locality in El Boleo mining district, Baja California, Mexico, where it is intimately associated, by epitaxy, with boléite. Detailed data on physical and optical properties, chemical and X-ray analyses, crystal morphology and structure, systematic position in the boléite group, and mineral genesis are included.—V.M.J.

9837 **Farlow, Neil H.; Blanchard, Maxwell B.; Ferry, Guy V.** Sampling with a Luster sounding rocket during a Leonid meteor shower: Jour. Geophys. Research, v. 71, no. 23, p. 5689–5693, illus., tables, 1966.

A Luster micrometeoroid sampling payload was successfully launched and recovered during the Leonid shower on November 16, 1965. Results to date indicate that the number of particles that may be of extraterrestrial origin is much smaller than predictions based on measurements from artificial Earth satellites and other sounding rocket collections.—D.B.V.

9708 **Fatt, I.; Maleki, M.; Upadhyay, R. N.** Detection and estimation of dead-end pore volume in reservoir rock by conventional laboratory tests: Soc. Petroleum Engineers Jour., v. 6, no. 3, p. 206–212, illus., 1966.

Conventional laboratory core analysis of two limestone reservoir rocks indicate that about 20 percent of PV is in dead-end pores. The tests were carried out on 3/4-in diameter test plugs; results show a clear difference between these samples and sandstone or homogeneous limestone reservoir rock. Although the amount of dead-end pore space can be only roughly estimated, its presence seems clearly indicated. Pressure transient data, although they do not give quantitative results, yield a reasonable estimate of the size of the neck connecting dead-end pores to the main flow channels.—*from* Authors' abstract

9826 **Fawcett, J. J.; Rucklidge, J. C.; Brooks, C. K.** Geological expedition to the Tertiary basalt region of Scoresby Sund, East Greenland: Nature, v. 212, no. 5062, p. 603–604, illus., 1966.

Field observations made in the summer of 1965 in the area of Tertiary lavas which stretches northwards from Kangerdlugssuaq to the Scoresby Sund fjord system in Greenland, are reported briefly. Laboratory investigations on the material collected are in progress.—D.B.V.

Fell, H. B. *See* Durham, J. Wyatt. 9894

9908 **Fell, H. Barraclough; Moore, Raymond C.** General features and relationships of echinozoans, *in* Treatise on invertebrate paleontology—Pt. U, Echinodermata 3, V. 1: New York, Geol. Soc. America (and Univ. Kansas Press), p. U108–U118, illus., 1966.

The subphylum Echinozoa includes the ancient classes Hellicoplacoidea, Edrioasteroidea, Ophiocistioidea, and Cyclocystoidea, with few genera, confined to the (mainly lower) Paleozoic, and the classes Echinoidea and Holothuroidea, with numerous genera, that range from Ordovician to Recent. The echinozoan structural pattern, fundamentally globoid, free-living, lacking arms or outspread rays, is compared with the homalozoan (carpoid), crinozoan (pelmatozoan), and asterozoan patterns. Evolution of the echinozoans from Lower Cambrian to Recent is discussed, with diagrams of postulated phylogenetic relationships.—V.M.J.

Fell, H. Barraclough. *See* Moore, Raymond C. 9909

9846 **Feltis, R. D.** Water from bedrock in the Colorado Plateau of Utah: Utah State Engineer Tech. Pub. 15, 82 p., illus., tables, 1966.

Bedrock aquifers in the three sections of the Colorado Plateau in Utah supply water differing widely in chemical quality and yield. The range of dissolved solids in 649 samples was from <100 to >390,000 ppm. Yield of wells ranged from <1 to 1,600 gpm and of springs from <1 to 121,000 gpm. In the Uinta Basin, wells and springs have produced fresh to slightly saline water from at least 13 formations, areal extent of fresh water is unknown, and in most of the central part, a thick sequence of Tertiary and underlying Cretaceous rocks contain water too saline for most uses. Canyon Lands section contains at least 19 aquifers with a wide variety of quality. The High Plains section receives greatest precipitation in the area, thus providing abundant recharge into bedrock aquifers and streams; very little water is withdrawn by wells from Paleozoic to Tertiary aquifers in relation to their potential yield.—M.C.M.

9942 **Ferguson, Stewart A.** Geology of Pickle Crow Gold Mines Limited and Central Patricia Gold Mines Limited, No. 2 operation: Ontario Dept. Mines Misc. Paper MP-4, 97 p., illus., tables, geol. maps, 1966.

In the areas described, Precambrian rocks include metabasalts and ash-flow tuffs with interbedded iron formation, porphyry stocks and dikes, and lamprophyre dikes. The major axial trends are northeast but some fold axes curve across the major axes. The folds have an isoclinal dip and are overturned on the southeastern limbs. Gold deposits occur as veins, and as quartz-sulphide deposits within iron formation. Practically all the production has been from the former type of occurrence. Surface and subsurface geologic mine maps are included.—*from* Author's abstract

Ferry, Guy V. *See* Farlow, Neil H. 9837

Fiedler, F. J. *See* Sherwood, W. C. 9537

9685 **Field, Cyrus W.** Sulfur isotopic method for discriminating between sulfates of hypogene and supergene origin: Econ. Geology, v. 61, no. 8, p. 1428-1435, tables, 1966.

The criterion for this distinction is that hypogene sulfate displays variable but appreciable S-34 enrichment relative to associated sulfide, whereas supergene sulfate is isotopically near-identical in composition to the parental sulfide. Results of this preliminary study indicate that alunite of the Bitter Creek area is of hypogene origin whereas alunite of the Mineral Park and Santa Rita areas is of supergene origin, as are gypsum and jarosite of the Gas Hills, Mineral Park, and Red River areas.—Author's abstract

Fine, L. O. *See* Swanson, Roger A. 9648

Fischer, A. G. *See* Durham, J. Wyatt. 9894

9502 **Fischer, Irene; Shirley, Ray; Wyatt, Philip.** A geoid profile in North America from a combination of astrogeodetic and gravimetric data: Jour. Geophys. Research, v. 71, no. 20, p. 4917-4920, illus., table, 1966.

Astrogeodetic deflections in the center of North America between latitudes 40° and 50° were gravimetrically interpolated to give several meridional profiles of the geoid. A uniform rectangular grid of anomalies was used to derive gravimetric deflections at 15′ intervals. A smaller area around each station should be considered if curvatures are computed first and then integrated into deflections.—Authors' abstract

9587 **Fischer, Irene.** Slopes and curvatures of the geoid from gravity anomalies by electronic computer: Jour. Geophys. Research, v. 71, no. 20, p. 4909-4916, illus., 1966.

The increasing use of gravity anomalies in geoid studies makes it mandatory that the tremendous amount of labor involved be streamlined and carried out by machine. A practical method is presented to cope with a mass production of deflections by carrying a uniform rectangular grid up to the immediate vicinity of all stations involved. The same method may be used to compute curvatures. Since curvature

values depend on a smaller survey area than do deflection values, the curvature method may often be advantageous.—Author's abstract

9588 **Fischer, Irene.** A revision of the geoid map of North America. Jour. Geophys. Research, v. 71, no. 20, p. 4905–4908, 1966.

The North American geoid map constructed by the U.S. Army Map Service in 1957 is being revised to accomodate new data accumulated since then. The computation of the geoidal heights is strengthened by the use of formulas which take the curvature of the Earth into account.—Author's abstract

9692 **Fisher, P. J.** The science of gems: New York, Charles Scribner's Sons, 189 p., illus., tables, 1966; originally published in England under title *Jewels* 1965.

In addition to their role in history, the nature of gems—their origin, composition, mineral crystals, mystery of light, and hardness—are described. Two chapters are devoted to diamonds, including their mining and cutting; one chapter covers other important gem stones; another the organic gems—pearls, amber, and coral; and the testing of gems is discussed in the final chapter. Appendixes include gem tables, conversion table, and distribution of diamond workers throughout the world in 1965. Some of the illustrations are in color.—G.D.C.

0064 **Fisher, Richard V.** Early Tertiary deformation in north-central Oregon: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 111–123, illus., 1967.

Structural and stratigraphic data from the Tertiary sequence indicates two related periods of deformation. The first period occurred prior to the deposition of the Oligo–Miocene John Day Formation and the latter period began in late John Day time and probably continued into early Columbia River Basalt (middle Miocene) time.—A.E.R.

9900 **Fisher, W. L.; Rodda, Peter U.** Nomenclature revision of basal Cretaceous rocks between the Colorado and Red Rivers, Texas: Texas Univ. Bur. Econ. Geology Rept. Inv. 58, 20 p., illus., tables, geol. map, 1966.

Basal Cretaceous rocks in Texas from Red River to Burnet County and on Callahan Divide are divided into three lithologic sequences. Recognized by facies changes and overlying definitive units, they include: 1) north-central sequence overlain by Glen Rose Formation and characterized by siliceous conglomerates and lack of carbonate units (Twin Mountains Formation, new name); 2) north and west-central sequences extending beyond pinch-out of the Glen Rose with basal and stratigraphically higher clastics included in the Antlers Formation; 3) central sequence overlain by the Glen Rose but characterized by carbonate units and coarse, locally derived limestone and dolomite conglomerates (Travis Peak Formation). The name Trinity is confusing and should be reserved for higher rank units, i.e. Group or Division, where such units are necessary and clearly defined.—*from* Authors' abstract

9486 **Flaate, Kaare.** Factors influencing the results of vane tests [with French abs.]: Canadian Geotech. Jour., v. 3, no. 1, p. 18–31, illus., 1966.

The influence of disturbance in evaluating the results of *in situ* vane shear tests in clays is examined. The influence of other factors, such as non-homogeneity of the soil mass and the mode of failure induced by the vane apparatus, are also examined and recommendations are made concerning testing methods and interpretation in order to take such factors into account.—Author's abstract

9547 **Flores, Romea Marzo.** Middle Allegheny paleogeography of eastern Ohio [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1512B, 1966.

0018 **Forgotson, J. M., Jr.** Current use of computers by exploration geologists [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 169, 1967.

9674 **Foster, R. W.** Sources and properties of lightweight shale aggregate in New Mexico [abs.]: Econ. Geology, v. 61, no. 8, p. 1470–1471, 1966.

9622 **Foster, Roy W.; Luce, Philip B.; Culver, Lewis G.; Maras, Burhanuddin B.** Preliminary investigations of the oil shale potential in New Mexico: New Mexico Bur. Mines and Mineral Resources Circ. 87, 22 p., illus., tables, 1966.

Over 4,800 qualitative and quantitative tests were made on New Mexico shales in an effort to locate commercial deposits of oil shale. To date, no extensive deposits have been found. Only gray and black shales that occur in quantity in Devonian, Pennsylvanian, Cretaceous and Tertiary rocks were tested. Low yield deposits were found in Pennsylvanian shales, especially near Abo Pass; in Cretaceous Mancos shale at Carthage and in the northwestern San Juan Basin; in Cretaceous Graneros shale near Springer; and in Tertiary Raton Formation near Raton. Additional testing of shales in southwestern New Mexico is needed to complete the evaluation.—M.S.T.

0088 **Franke, O. L.** Steady-state discharge to a partially penetrating artesian well—An electrolyte-tank model study: Ground Water, v. 5, no. 1, p. 29–34, illus., table, 1967.

A systematic investigation of the steady-state discharge to wells that partially penetrate a homogeneous and isotropic non-leaky artesian aquifer was made using an electrolyte-tank model. The experimental results were compared with discharge calculated by methods developed by several previous writers. This comparison showed that the formula of Li, Bock, and Benton (1954) gave the most reliable results over the widest range of the appropriate geometric variables.—Author's abstract

Freeze, R. A. *See* Meyboom, Peter. 9612

Frey, Fred A. *See* Haskin, Larry A. 9815

9913 **Frizzell, Don L.; Exline, Harriet; Pawson, David L.** Holothurians, *in* Treatise on invertebrate paleontology—Pt. U, Echinodermata 3, V. 2: New York, Geol. Soc. America (and Univ. Kansas Press), p. U641–U672, illus., 1966.

The Holothuroidea are a class of mostly free-living echinozoans, closely related to echinoids, with typically cylindrical body elongated orally-aborally, lacking an articulated test. Skeletal elements are usually reduced to very numerous, microscopic sclerites of varied shape. Holothuroids range from Devonian (possibly Ordovician) to Recent. Complete fossil remains are extremely rare, only three species being known; dissociated fossil sclerites are abundant, and are classified by a separate system (55 form genera). A single classification system incorporating fossil and extant taxa has been attempted but is not entirely satisfactory. Systematic descriptions of all fossil taxa to the generic level are given; exclusively Recent forms are not described but are referred to briefly under morphology, phylogeny and evolution. Sclerites species are listed in order of stratigraphic occurrence.—V.M.J.

Fuller, R. K. *See* Nuckolls, M. J. 9804

Fyfe, W. S. *See* Carmichael, I. S. E. 9771

Gamble, E. E. *See* Daniels, R. B. 9606

9679 **Garlick, G. Donald; Epstein, Samuel.** The isotopic composition of oxygen and carbon in hydrothermal minerals at Butte, Montana: Econ. Geology, v. 61, no. 8, p. 1325–1335, illus., table, 1966.

Isotopic fractionation of oxygen in quartz decreases from central to outer portions of mineralized area, in a direction opposite to the trend expectable from temperature considerations. Mixing of O^{18}-poor meteoric water with magmatic water is the preferred explanation. Wall-rock alteration has involved depletion in O^{18}. Oxygen isotope ratios of quartz-carbonate pairs give erratic results, suggesting that the minerals did not form contemporaneously in equilibrium. Quartz-magnetite pairs suggest "temperatures of 680°C and 440°C for the quartz-monzonite and pre 'Main-Stage' vein, respectively."—W.S.W.

9614 **Garza, Sergio.** Ground-water resources of the San Antonio area, Texas—A progress report on studies, 1960–64: Texas Water Devel. Board Rept. 34, 31 p., illus., tables, 1966.

This report supplements the previously published work concerning the geology and hydrology of the Edwards and associated limestones in the San Antonio area and brings the hydrologic data up to date through 1964. The report presents records of precipitation, streamflow, and water level; it gives estimates of recharge to and discharge from the aquifer. Estimates of changes in storage in the aquifer are made by using the recharge and discharge figures. The relation of the aquifer head to the changes in storage and the movement of water is discussed. Also provided is a summary of the studies of the quality of water in the zone of transition between water of good quality and saline water in the aquifer.—*from* Author's introduction

Gauri, K. L. *See* Boucot, A. J. 9847

Geddes, W. *See* Zietz, Isidore. 9775

9824 **Gees, R. A.** Porosity determination using modal analysis on thin sections of rock and core material and simulated well cuttings [with French, German, and Russian abs.]: Geol. Rundschau, v. 53, no. 3, p. 848–855, illus., tables, 1966.

Porosities of rock samples obtained by modal analysis and by the gas expansion method are compared. Results indicate that modal analysis is a suitable method for determining porosities of rock samples, especially well cuttings.—Author's abstract

9534 **Geitgey, R. P.; Mitchell, R. S.** Pseudomorphs of anatase after perrierite masses from Amherst County, Virginia [abs.], *in* Virginia Acad. Sci. Proc. 1965–66: Virginia Jour. Sci., new ser., v. 17, no. 4, p. 318, 1966.

Gemperle, Michael. *See* Dehlinger, Peter. 9929

9789 **Geological Society of America.** (Southeastern Section). Extrusive volcanic rocks and associated dike swarms in central-east Georgia—Guidebook, Field Trip 2, April 1966: Athens, Ga., Univ. Georgia Dept. Geology, 53 p., illus., table, 1966.

This guidebook consists of a paper and road log by T. J. Crawford, V. J. Hurst, and L. D. Ramspott (cited separately).—E.S.L.

9830 **Geological Society of America.** (Southeastern Section). Stratigraphy and economic geology of the coastal plain of the central Savannah River area, Georgia—Guidebook, Field Trip 3, April 1966: Athens, Ga., Univ. Georgia Dept. Geology, 30 p., illus., table, 1966.

This guidebook consists of a paper and road log by J. Sandy, R. E. Carver, and T. J. Crawford (cited separately).—E.S.L.

George, P. *See* Bennett, G. 9697

George, P. *See* Bennett, G. 9701

9636 **Gerber, Carl R.; Voress, Hugh E.** (compilers). A selected, annotated bibliography of the civil, industrial, and scientific uses for nuclear explosives: U.S. Atomic Energy Comm. Rept. TID-3522 (8th rev.), 108 p., illus., 1966.

This bibliography presents annotated references arranged by subject. A guide to where the reports may be obtained and their cost, a separate listing of the films available, and an index of where information on specific projects may be found follow the annotated references. Author and number indexes are also included.—Authors' abstract

9535 **Giannini, W. F.; Young, R. S.** Illite zones in New Market ("Mosheim") limestone, Stephens City, Virginia [abs.], *in* Virginia Acad. Sci. Proc. 1965–66: Virginia Jour. Sci., new ser., v. 17, no. 4, p. 319, 1966.

9595 **Gipson, Mack, Jr.** A study of the relations of depth, porosity and clay mineral orientation in Pennsylvanian shales: Jour. Sed. Petrology, v. 36, no. 4, p. 888–903, illus., 1966.

The relations between porosity, preferred clay mineral orientation, and mineralogy with respect to present burial depths up to about 1,500 feet were investigated for samples of shales of Pennsylvanian age in western Kentucky. Statistical tests showed that porosity decreases slightly with depth but is strongly influenced by increases in illite content and preferred orientation. Preferred orientation is independent of depth but increases with increasing clay content. Illite and chlorite are inversely correlated and illite increases with depth. This suggests the conversion of chlorite to illite.—H.A.T.

9600 **Gipson, Mack, Jr.** Preparation of oriented slides for X-ray analysis of clay minerals: Jour. Sed. Petrology, v. 36, no. 4, p. 1143–1162, illus., 1966.

Glass and aluminum microscope slides are supported on inverted petri dishes at the bottom of 1000-ml beakers. Suspensions of clay less than two microns obtained by settling are siphoned into the beakers, allowed to settle over night and siphoned out again. Very smoothly coated slides with well oriented clay minerals resulted.—H.A.T.

9765 **Goldich, Samuel S.; Muehlberger, William R.; Lidiak, Edward G.; Hedge, Carl E.** Geochronology of the midcontinent region, United States—[Pt.] 1, Scope, methods, and principles: Jour. Geophys. Research, v. 71, no. 22, p. 5375–5388, illus., table, 1966.

The history of the Precambrian basement in the midcontinent region of the United States (Appalachians to the Rocky Mountains, Canadian shield to the Gulf Coastal Plain) has been interpreted with the aid of isotopic age determinations, geologic data, and geophysical observations. The analytical methods and some problems relating to interpretation are discussed in this introductory paper.—D.B.V.

9766 **Goldich, Samuel S.; Lidiak, Edward G.; Hedge, Carl E.; Walthall, Frank G.** Geochronology of the midcontinent region, United States—[Pt.] 2, Northern area: Jour. Geophys. Research, v. 71, no. 22, p. 5389–5408, illus., tables, 1966.

Radiometric age determinations on core samples from the Precambrian basement of the northern midcontinent region of the United States permit new interpretations of Precambrian history. The Black Hills orogeny, 1,700 m.y. ago, was essentially synchronous with the Penokean orogeny of the Lake Superior district; the orogenic belt extends from Kansas to Saskatchewan, and probably merges with the Hudsonian belt of the Churchill province of the Canadian shield. A period of granite intrusion in Nebraska is dated at 1,490 m.y., and somewhat younger granites in South Dakota and Nebraska as 1,430 m.y. A long belt of middle Keweenawan flows and related rocks extending from Lake Superior to Kansas was formed about 1,100 m.y. ago.—D.B.V.

9801 **Goldthwait, Richard P.** Glacial history, Pt. 1 *in* Soil development and ecological succession in a deglaciated area of Muir Inlet, southeast Alaska: Ohio State Univ. Inst. Polar Studies Rept. 20, p. 1–18, illus., 1966.

The origin of materials on which soils and ecosystems have developed in this area of Muir Inlet involves the last two glacial invasions and pro-glacial waters since 8500 B.C. These drifts (late Wisconsin to present) comprise eight formations of glacial, glacio-fluvial, and glacio-marine origin. Evidence indicates that the last and greatest advance of post-Wisconsin ice reached its southernmost point just south of Bartlett Cove between 200 and 300 years ago; since then there has been phenomenal retreat, ice thinning near the edge at rates generally from 3–12 m per yr. Shores are emerging at over 4 cm per yr as the great ice load is removed from the land, so the shore environment has widened several meters each century, making new land available to plants, animals, and soil-forming processes.—M.C.M.

9861 **Gómez González, Jesús.** La fotointerpretación aplicada al proyecto de vías terretres, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965,

Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 348–356, 1966.

The case of Isla–San Juan Evangelista in the State of Veracruz is cited as an example of the use of photogeology in planning for high construction in Mexico. In addition to reports of field reconnaissance, 99 airphotos on a scale of 1:50,000 were studied stereoscopically for selection of route, delimitation of types of soil, location of construction materials, and identification of drainage problems. A second photogeologic study, on the scale of 1:10,000, was recommended for the most favorable routes. The major problems were two large rivers and numerous arroyos.—G.D.C.

9890 **Gordon, W. A.** Two crab species from the middle Tertiary of Puerto Rico, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 184–186, illus., 1966.

A small collection of fossil decapod material has been made principally from the San Sebastián formation and Ponce limestone of Puerto Rico. The specimens are fragmentary but they are the first fossil decapod material to be reported from the island. Two different forms occur in the collection—*Necronectes proavitus* (Rathbun) from the San Sebastián formation and a species of *Portunus* resembling *P. oblongus* Rathbun from the Ponce limestone.—Author's abstract

0076 **Gould, Howard R.** Sedimentary facies and their importance in oil finding [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 167, 1967.

0050 **Graf, D. L.; Blyth, C. R.; Stemmler, R. S.** One-dimensional disorder in carbonates: Illinois Geol. Survey Circ. 408, 61 p., illus., tables, 1967.

The X-ray diffraction effects expectable for carbonate crystals having one dimensional disorder are examined by programming a digital computer for the most general of the Hendricks–Teller equations. The unambiguous evidence for CaMg carbonate mixed layering available thus far is found in a few zero-level α-axis Weissenberg diagrams. The nonideality of the basal cation plane succession apparently involves the distribution of pure Mg layers and Ca-substituted Mg layers, rather than the insertion of extra Ca layers.—*from* Authors' abstract

0091 **Graffham, A. Allen.** Type locality of *Cordania falcata*: Oklahoma Geology Notes, v. 27, no. 1, p. 14–15, illus., 1967.

The type locality for the holotype of *Cordania falcata* has been changed from Murray County, as given in the original description (Whittington, 1960), to Coal County. The correction was confirmed by the collector.—B.S.H.

Granger, H. C. *See* Dooley, J. R., Jr. 9777

0085 **Gratton, Patrick J. K.; Lamay, William J.** Ground rules for San Andres exploration [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 170, 1967.

Graul, Hans. *See* Rathjens, Carl. 9812

Gregory, Joseph T. *See* Camp, Charles L. 0047

9621 **Grice, R. H.** Engineering geology of the Montreal subway: Eng. Geology, v. 3, nos. 1–2, p. 59–64, illus., 1966.

The nearly completed 16-mile long Montreal subway cuts Ordovician crystalline limestone, shaly limestone, shaly mudstone, and locally igneous rock. Attitudes and nature of the joint systems and the geologic contacts have been recorded to determine their effect on tunnel construction. The construction characteristics of the rock units are defined from core and tunnel observations and from laboratory testing to plan for future construction in Montreal and to develop procedures for interpretation of core and other exploratory data. Geologic factors that influenced

construction are lithologic units present, frequency and attitude of joints and faults, and nature of the across-joint bonds.—M.S.T.

9715 **Grimm, F. Wayne.** Speciation in the *Triodopsis fallax* complex (Mollusca: Gastropoda: Pulmonata) [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 82, no. 2, p. 101–102, 1966.

9730 **Gross, W. H.; Strangway, D. W.** Remanent magnetism and the origin of hard hematites in Precambrian banded iron formation, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 366–378, illus., tables, reprinted 1966; originally published 1961.

Field examples of two ore bodies (in Mauritania) are cited to illustrate the thesis that hematite ore bodies within iron formations are good subjects for study of remanent magnetism and that analysis of remanent magnetic directions may be useful in determining the origin of hematite ore bodies. Such information is of practical importance in locating the concentrations that make important bodies of shipping ore.—V.S.N.

9881 **Grossman, I. G.** Fluctuations of ground-water levels in Puerto Rico resulting from earthquakes (1959–1961), *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 104–106, illus., table, 1966.

During the Chilean earthquake of May 22, 1960, intensity 8.5, 4 of 8 wells in Puerto Rico equipped with automatic recorders, recorded seismic fluctuations. The maximum double amplitude, 0.05 ft, was recorded at a well in bedrock near Coamo. Double amplitudes in 3 other wells ranged from slightly less than .01 to .02 ft. Following the Puerto Rico earthquake of Aug. 2, 1961, intensity about 5.5, seismic fluctuations were recorded in 3 of 9 wells. The maximum double amplitude of these fluctuations ranged from .07 ft in a well in alluvium to .01 ft each in 2 wells in bedrock. Two wells showed seismic responses to both earthquakes and in both cases greater fluctuations resulted from the more distant but more intense Chilean quake. No lasting changes in water levels or yields of wells have been recorded as a result of quakes occurring during the period of record.—*from* Author's abstract

9848 **Guerra Peña, Felipe.** Las regiones fisiográficas de la isla de Santo Domingo, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 209–225, illus., 1966.

Physiographic divisions of the Dominican Republic have been changed over the years of the last century as increasing knowledge of geology, rock composition, structure and tectonics became available. The early basis was limited to topographic features of relief. The major regions are described briefly and illustrated by photo copies of relief maps.—G.D.C.

9858 **Guerra Peña, Felipe.** La erosión en la interpretación geográfica de las fotografías áéreas, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 301–307, 1966.

Three geomorphologic keys are considered in this discussion of photogeologic interpretation. Two are normal—erosion considered as cause or agent, and drainage as effect—and one abnormal—geomorphologic anomalies which are exceptional. Analysis of airphotographs produces evidence of the erosive agent; evolution of landforms; nature and constitution of the rocks involved; geologic structure, particularly folded; and lineation of the tectonics where reflected in the surface openly or covered by thick unconsolidated sediments. Erosion takes the lines of least resistance.—G.D.C.

9944 **Guerra Peña, Felipe.** Importancia de la red hidrográfica, considerada como clave analítica para la identificación de las imágenes fotográficas aéreas de los rasgos naturales [with English summ.]: México Univ. Nac. Autónoma Anuario Geografía 1964, v. 4, p. 27–164, illus., table, 1966.

The hydrographic net is the product of erosive agents, and associated natural phenomena can be best analyzed by stereographic observation of hydrographic characteristics on airphotos. The drainage pattern reveals topographic relief; geomorphic cycle; lithology and rock qualities such as hardness, homogeneity, and permeability; geologic structure alinements; and weak zones of the Earth's crust. In statistical airphoto analysis of drainage the factors of density, continuity grade, and texture are complementary among themselves.—G.D.C.

Guillet, G. R. *See* Hewitt, D. F. 9698

Gur'yanova, V. N. *See* Bogdanov, Yu. V. 9586

9937 **Guzmán A., Alejandro.** El uso de las fotografías aéreas en el estudio de las costas *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 319–328, illus., 1966.

Aerial photographs are used in the study of cartographic elements for shoreline maps of importance to navigation and for regional studies of coastal forms and geologic structure. The various cartographic features are identified for backshore, foreshore, and offshore zones. In regional studies airphotos reveal the predominant structural configuration—longitudinal, transverse, oblique, arcuate, or reticulate—influenced by faults, folds, Appalachian structure, embayments, jointed networks, and volcanic features. Four reproduced airphotos illustrate some of these shore features.—G.D.C.

9686 **Hagni, Richard D.; Desai, Arvind A.** Solution thinning of the M bed host rock limestone in the Tri-State district, Missouri, Kansas, Oklahoma: Econ. Geology, v. 61, no. 8, p. 1436–1442, illus., 1966.

In the Picher field, the M bed is typically 20–30 feet thick in the vicinity of ore deposits; thicknesses up to 70 or 80 feet occur outside the mining field. The Galena and Melrose fields exhibit similar but less well defined zonal patterns of M-bed thicknesses. The thinning is attributed partly to solution related to the post-Keokuk erosion surface and later surfaces, and partly to solution by the ore-forming fluids.—W.S.W.

0061 **Halbouty, Michel T.** Our profession's challenge and responsibility: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 124–125, 1967.

Geologists need to find new exploration methods for finding oil.—W.C.C.

0074 **Halbouty, Michel T.** Economics—The essential requirement in exploration [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 166, 1967.

9510 **Hallof, Philip G.** Geophysical results from the Orchan Mines, Ltd., property in the Mattagami area of Quebec, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 157–171, illus., 1966.

The geology of the Mattagami and the Mattagami Lake-Orchan areas is reviewed. Magnetic, electromagnetic, and induced polarization results are discussed and illustrated with maps. The first two methods revealed the No. 1 orebody, but not Nos. 2 and 3 because of their depth; however, anomalous IP zones correlated with all three orebodies. Detailed geophysical results are given for each orebody; only No. 1 contains magnetic material.—E.S.L.

9726 **Hallof, Philip G.** Induced-polarization and resistivity results from the Cactus deposit, Miami, Arizona, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 313–316, illus., 1966.

In a reconnaissance geophysical program to locate disseminated mineralization of the porphyry copper type, the Cactus deposit would certainly have been located by the induced-polarization method. The deposit is too small in tonnage to be ore today, but because it is small, and at depth, it is a good test for the IP method.—E.S.L.

9548 **Hamill, Gilmor Semmes, 4th.** Structure and stratigraphy of the Mt. Shader quadrangle, Nye County, Nevada—Inyo County, California [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1512B, 1966.

9487 **Hamilton, A. B.** Freezing shrinkage in compacted clays [with French abs.]: Canadian Geotech. Jour., v. 3, no. 1, p. 1–17, illus., table, 1966.

The results of volume change measurements on laboratory-compacted samples of five Alberta clay soils which have been subjected to closed-system, unidirectional freezing are presented. For Standard AASHO compaction effort, maximum shrinkage occurred at degrees of saturation between 60 and 70 percent. The compacted degree of saturation required for 0 percent total volume change ranged from 86 to 90 percent. Maximum freezing shrinkage was found to increase with an increase in plasticity of the soil. Increasing the compactive effort from Standard to Modified AASHO caused a reduction in the maximum measured shrinkage in a highly plastic, lacustrine clay. A hypothesis, based on Powers' and Helmuth's theory of volume changes in cement pastes on freezing, is suggested as an explanation of the observed behavior.—*from* Author's abstract

9661 **Hansen, Don A.** Physical concepts and factors effecting induced polarization response, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. A: Nevada Bur. Mines Rept. 13, pt. A, p. 23–38, illus., 1966.

Because of the importance of induced polarization surveys in mineral exploration, it is appropriate to discuss some of the many factors that must be considered in their planning and interpreting. This paper, directed to the non-geophysicist, is illustrated by line drawings approximating complicated situations which actually exist, at scales from macroscopic to submicroscopic. Modes of current flow are mentioned, minerals are classified as ionic and electronic conductors, and overburden resistivity, membrane polarization, and sulfide polarization depending on pore path, grain, content of sulfides, and geometry of ore body and disturbing factors in its environment are discussed. In summary, an hypothetical geologic section indicates these factors and others not discussed, and summarizes their bearing on interpretation of data.—G.D.C.

9724 **Hansen, Don A.; Barr, David A.** Exploration case history of a disseminated copper deposit, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 306–312, illus., 1966.

The Krain disseminated sulfide deposit is in the Guichon batholith approximately 130 airline miles northeast of Vancouver, British Columbia. Determinations of exchangeable copper content of stream sediments and of soils showed highest values near the deposit. Ground magnetometer and self-potential surveys displayed no diagnostic variations over the deposit. A variable frequency induced-polarization survey showed a response having excellent correlation with the known extent of the sulfide mineralization.—Authors' abstract

9729 **Hansen, Don A.** Introduction [*to* The search for iron ore, Chap. 5], *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 359–365, illus., table, 1966.

In the application of geophysical methods to iron exploration, the physical properties of the ore, the minerals, and the environment are important. Iron deposits are classified by genesis into ores associated with igneous rocks, sedimentary ores, and ores from weathering of igneous rocks and sulfide bodies. Magnetic surveying is the most widely applied method because of the magnetite. Use of gravity surveying is increasing, although the low specific gravity of some orebodies, and the surface and subsurface topography can cause problems. The use of electrical methods has been experimental so far.—E.S.L.

0075 **Hanson, Bernold M.** Bar-Mar field, the tricky Devonian [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 166–167, 1967.

9549 **Hanson, Hiram Stanley.** Petrography and structure of the Leatherwood Quartz Diorite, Santa Catalina Mountains, Pima County, Arizona [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1512B–1513B, 1966.

9781 **Hansuld, John A.** Behavior of molybdenum in a secondary dispersion media—A new look at an old geochemical puzzle: Mining Eng., v. 18, no. 12, p. 73–77, illus., 1966.

The chemistry of molybdenum with its six different oxidation states is complex. Its mobility in the secondary geochemical cycle is controlled largely by the stability relations among its various oxidation products. Simple Eh–pH diagrams are useful in predicting and properly understanding the behavior of molybdenum in such secondary dispersion media as water, soil, and vegetation.—F.C.C.

9575 **Hardie, Byron S.** Carlin gold mine, Lynn district, Nevada, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. A: Nevada Bur. Mines Rept. 13, pt. A, p. 73–82, illus., 1966.

Gold of Tertiary age is being produced from the Carlin mine, in northern Eureka County, Nev. The ore occurs along a northeast-trending fault zone in fractured siltstone and limestone of Silurian and Devonian age below the Roberts Mountains thrust fault. The ore is largely oxidized, and the gold occurs in particles mostly smaller than five microns in altered and iron oxide stained rock. Galena, cinnabar, stibnite are found locally in the ore zone. Discovered in 1962 after intensive prospecting along certain recommended mineral belts in north-central Nevada, the Carlin mine ore reserves, by 1964, totalled 11 million tons containing about 3.5 million ounces of gold. A cyanide mill of 2,000 tons daily capacity was put into operation in May, 1965.—*from* Author's abstract

9807 **Harksen, J. C.** The Pliocene–Pleistocene Medicine Root gravel of southwestern South Dakota: Southern California Acad. Sci. Bull., v. 65, no. 4, p. 251–257, illus., 1966.

The Medicine Root gravel (informal name) of southwestern South Dakota is the result of cut and fill action of major streams draining eastward from the Black Hills area in Pliocene–Pleistocene times. The gravel is found mantling many topographic highs in northern Shannon and Washabaugh Counties; it consists of sand and gravel, the latter being the major constituent. All size fractions are present, however. The gravel is extremely heterogeneous in lithology and fossil content. The name, Medicine Root gravel, is derived from Medicine Root Creek, and is proposed as an informal name. When the exact relationship of these gravels to the Pliocene–Pleistocene boundary has been determined, the name will be proposed as a formal stratigraphic unit.—M.S.T.

Harper, Charles. *See* Boucot, A. J. 9751

9625 **Harper, Francis.** Palisor de Beauvois and the natural walls of Rowan County, North Carolina [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 82, no. 2, p. 92, 1966.

0073 **Harris, Frank G., 3d.** Walter William Butcher (1916–1966): Am. Assoc. Petroleum Geologist Bull., v 51, no. 1, p. 142, portrait, 1967.

9498 **Harrison, J. C.; VonHuene, R. E.; Corbató, C. E.** Bouguer gravity anomalies and magnetic anomalies off the coast of southern California: Jour. Geophys. Research, v. 71, no. 20, p. 4921–4941, illus., 1966.

Marine and land gravity measurements in the area bounded by long 117°00′ and 120°00′ W. and lat 34°30′ and 32°30′ N. have been compiled and a map of Bouguer anomalies drawn. The short-wavelength components of the anomalies show a pronounced NW–SE strike, and correlate with structures parallel to the Coast Ranges. The intermediate-wavelength components show a pronounced east-west strike, parallel to but extending beyond the Transverse Ranges. The transition between oceanic and intermediate borderland crust is very abrupt. The M discontinuity appears to dip >45° beneath the continental slope. Total magnetic anomalies show two offshore features interpreted as intrusive masses, possible

sources for the volcanic rocks of Santa Barbara area and San Clemente Islands.—D.B.V.

9712 **Hart, Donald L., Jr.** Base of fresh ground water in southern Oklahoma: U.S. Geol. Survey Hydrol. Inv. Atlas HA-223, 2 sheets, scale 1:250,000, text, 1966.

The map area is divided into southwestern and south-central Oklahoma on the two sheets, each map showing the altitude of the base of fresh ground water; insert maps indicate areal distribution of lowest bedrock units containing fresh water and depth to base of the fresh-water body. Fresh water is contained in unconsolidated deposits, sandstone, crevices and solution cavities in limestone or gypsum beds, fractures in shale, or crevices in igneous and metamorphic rocks. Yields of wells range from less than one to more than 3,000 gpm, depending upon thickness, permeability, and areal extent of the tapped water-bearing zone.—M.C.M.

9634 **Hartzog, Laurence D.** Atomic absorption spectrophotometry for the mining industry, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. B: Nevada Bur. Mines Rept. 13, pt. B, p. 113-116, illus., table, 1966.

From the viewpoint of the mining industry, atomic absorption is one of the most significant advances in analytical chemistry in this century. It allows the exploration geologist to make geochemical surveys of thousands of samples, and the mill and mine man an extremely rapid and precise method of grade control. These advantages are due to extreme rapidity, high precision and accuracy, very high sensitivity, and exceedingly low cost. Typical detection limits for elements of commercial interest are tabulated from results reported from various laboratories around the world. The absorption technique measures a much larger percentage of the total number of atoms present than does the emission technique.—G.D.C.

9863 **Harvey, Richard D.** Electron microscope study of microtexture and grain surfaces in limestones: Illinois Geol. Survey Circ. 404, 18 p., illus., 1966.

Electron micrographs of direct-carbon replicas having magnifications of 5,400 to 23,500 times reveal details of the particles comprising very fine-grained limestones, but only portions of a few grains in medium- or coarse-grained limestones. Eighteen electron micrographs illustrate microtexture of tensile and shear fracture surfaces, ground surfaces, and grain surfaces and contacts.—E.S.L.

9815 **Haskin, Larry A.; Wildeman, Thomas R.; Frey, Fred A.; Collins, Kenneth A.; Keedy, Curtis R.; Haskin, Mary A.** Rare earths in sediments: Jour. Geophys. Research, v. 71, no. 24, p. 6091-6105, illus., 1966.

The relative elemental abundances of the rare earth elements (REE) in a composite of 40 North American shales and the average for 38 individual sediment samples are found to be identical with each other and with the average Russian Platform sediments. The average RE distributions for several carbonates, sandstones, graywackes, and ocean sediments are identical with that of the composite shale; the individual sediment distributions are identical with it in 14 out of 38 cases and close in the rest. Absolute RE contents are discussed. The bulk of the REE are in the quartz in St. Peter Sandstone, in the carbonate in Byron Formation limestone. Experiments on adsorption of REE on calcite are described.—D.B.V.

Haskin, Mary A. *See* Haskin, Larry A. 9815

9676 **Hausen, Donald M.; Kerr, Paul F.** Fine gold occurrence at Carlin, Nevada [abs.]: Econ. Geology, v. 61, no. 8, p. 1468-1469, 1966.

Hedge, Carl E. *See* Muehlberger, William R. 9736

Hedge, Carl E. *See* Goldich, Samuel S. 9765

Hedge, Carl E. *See* Goldich, Samuel S. 9766

Heezen, Bruce C. *See* Schneider, Eric D. 9774

Hege, E. K. *See* Bell, R. Thomas. 9529

9725 **Heinrichs, Walter E., Jr.; Ludwig, C. S.** Results of an induced-polarization survey employing both time and frequency domain techniques, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 317–320, illus., 1966.

The application of time domain and frequency domain IP techniques on the same anomaly gave similar results. Differences in data are due to differing electrode geometry rather than inherent differences in the two techniques. When properly equated, the two different methods give identical results for most practical purposes.—Authors' abstract

Heirtzler, J. R. *See* Pitman, W. C., 3d. 9845

9809 **Henderson, J. F.** (compiler). Current research in the geological sciences in Canada, 1965–66: Canada Geol. Survey Paper 66–53, 197 p., 1966.

The research projects listed in this bibliography have been obtained from the universities, federal and provincial departments of mines, and other non-industrial institutions carrying on research in the geological sciences in Canada. With the exception of a few projects, the bibliography does not include research by mining and oil company geologists. The survey was made between December 1965 and April 1966 and records research in progress for about the period June 1965 to May 1966. Projects are grouped under main headings that cover the different branches of the geological sciences. An author index lists after each author the numbers of current projects, as listed in the bibliography. Thus by reference to the author index, the fields of research and the projects of any worker may be found.—*from* Author's introduction

Henika, W. S. *See* Delaney, J. R. 9662

9583 **Henley, Aubrey D.** Seismic activity near the Texas Gulf Coast: Eng. Geology, v. 3, nos. 1–2, p. 33–39, illus., 1966.

Seismic stations recently installed in the Gulf Coastal Plain, Texas, have recorded to date 70 localized high-frequency seismic events. Computer analysis of these records shows the epicenters to be east-northeast of Pineland, Sabine County, Tex. The cause is thought to be the rapidly subsiding continental shelf area of the Gulf of Mexico. The data recorded indicate that seismic activity constitutes no major problem to construction and operation of large earth structures in the area.—M.S.T.

Henry, Vernon J., Jr. *See* Hoyt, John H. 0069

9914 **Herreid, Gordon.** Geology and geochemistry of the Nixon Fork area, Medfra quadrangle, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 22, 37 p., illus., tables, geol. map, 1966.

Stream sediment geochemical samples were taken in the Nixon Fork area, where contact metamorphic gold-copper deposits occur in limestone around a quartz monzonite-quartz latite stock, to determine the reflection of known deposits and to detect unknown deposits. Soil samples taken below known deposits show moderate to low anomalies for a few hundred feet down. Cold extractable heavy metal field tests are in good agreement with copper, lead, and zinc contents of highly anomalous samples, but in fair to poor agreement with moderately anomalous samples. Stream sediment samples moderately anomalous in zinc, taken near the north end of the stock, may be indicative of undiscovered deposits. Three moderate stream anomalies in the northern part suggest a mineral potential in the zone of faults and small intrusives.—B.S.H.

Heubach, H. G. *See* Chilton, Frank. 9816

9698 **Hewitt, D. F.; Appleyard, E. C.; Guillet, G. R.** Madoc township (north part), Hastings county: Ontario Dept. Mines Prelim. Geol. Map P. 368, scale 1 in. to 1/4 mi., 1966.

9479 **Hibbard, Claude W.; Dalquest, Walter W.** Fossils from the Seymour Formation of Knox and Baylor Counties, Texas, and their bearing on the late Kansan climate of that region: Michigan Univ. Mus. Paleontology Contr., v. 21, no. 1, p. 1–66, illus., tables, 1966.

The vertebrates recovered from the Seymour Formation are listed. A systematic description is given of the fossil mammals. The presence of the Pearlette volcanic ash establishes the age of the fossils as no younger than late Kansan [early middle Pleistocene]. The vertebrates recovered from the sand, gravel, and sandy silt below the horizon of the Vera faunule of the Cudahy [Kansas] fauna are regarded as a distinct local fauna, the Gilliland, post-Blancan and pre-Cudahy in age, considered to be the same age as the Holloman local fauna of Oklahoma and the Rock Creek local fauna of Texas. Twenty-two genera of mammals were recovered in association with specimens of a giant land tortoise, *Geochelone*, an indicator of frost-free climate. The associated fauna indicates a maritime climate with more effective moisture than now.—*from* Authors' abstract

0059 **Higgins, G. E.; Saunders, J. B.** Report on 1964 Chatham Mud Island, Erin Bay, Trinidad, West Indies: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 55–64, illus., table, 1967.

In August 1964, a mud island appeared in Erin Bay, Trinidad, accompanied by blowing gas, and rose to a height of about 25 feet and covered an area of 10 1/2 acres in a few days. It was composed of silty clay of Miocene age with numerous boulders that were principally sandstone. It disappeared by compaction and erosion eight months later. The force causing the extrusion of the mud could have been tectonic, the result of gas pressure, or both. Tectonic movement probably was the principal force.—W.C.C.

0071 **Hilpman, Paul L.; Walters, Robert F.** Walter Wendell Schell Johns (1911–1963): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 143–144, portrait, 1967.

9732 **Hinze, William J.** The gravity method in iron ore exploration, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 448–464, illus., revised 1966; originally published 1960.

The gravity method has proven to be especially useful in the study of large tonnage, wide, near-surface taconite-type orebodies that have been the primary concern of the iron ore industry during the past decade. It was first applied as a tool for detecting nonmagnetic ores, but advantages of this method have made it useful also in the study of magnetic ores and regional structures favorable for the occurrence of iron ore. Limitations of the gravity method are: the anomalous property is less diagnostic than the magnetic; detection of beds of waste material in ores, which have no density contrast; the effect of bedrock relief; the effect of the regional anomalies; anomalies are broader, less definitive, than magnetic; and greater expense. Four typical examples are given from the Lake Superior region.—E.S.L.

9488 **Ho, Michael K.** Swelling measurement and prediction of heave for a lacustrine clay [discussion of paper by C. A. Noble, 1966]: Canadian Geotech. Jour., v. 3, no. 3, p. 169–172, illus., 1966.

Graphs of two families of curves which may be obtained from the empirical relationship between volume change, applied load, and initial water content are presented to supplement the practical applications of Noble's (ibid., v. 3, no. 1, p. 32–41, 1966) systematic study of swelling characteristics of an expansive clay. The first graph shows swelling characteristics of remolded specimens subject to constant surcharge load in the free-swell tests conducted in oedometers; from these curves, amount of volume change may be predicted for any chosen quantity of surcharge load, if the initial water content of the remolded specimen is known; swelling pressure at zero volume change may also be determined. In the second graph, for any constant amount of volume change, the swelling pressure may be determined from known values of initial water content of the remolded specimen.—V.M.J.

Holland, Heinrich D. *See* Puchner, Herbert F. 9684

9550 **Hollister, Lincoln Steffens.** Electron microprobe investigations of metamorphic reactions and mineral growth histories, Kwoiek area, British Columbia [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1513B, 1966.

Holman, R. H. C. *See* Emslie, R. F. 9610

9538 **Holte, Karl Emrud.** A floristic and ecological analysis of the Excelsior fen complex in northwest Iowa [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1377B, 1966.

9577 **Horton, Robert C.** Statistical studies of the distribution of mining districts in Nevada, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. A: Nevada Bur. Mines Rept. 13, pt. A, p. 109–123, illus., tables, 1966.

Mining districts and mineral deposits of Nevada have an exponential probability distribution, not substantially altered by discoveries made so far. The difficulty in finding new deposits is not because there are fewer to be found, but rather that they are less obvious. Some statistical evidence supports the hypothesis of concentration in at least two belts; additional evidence may be found with more sophisticated statistical tests. Probability values obtained from a table of Chi squared values suggest random distribution of mining districts, silver, copper, and lead deposits, but not gold. A specific area of the proposed mineral belts was analyzed by a square and rectangular quadrats, oriented N. 45° W., paralleling many of these belts. Probability distributions were charted and two-way analysis of variance tabulated.—G.D.C.

Hovland, Dwight. *See* Swanson, Roger A. 9648

0069 **Hoyt, John H.; Henry, Vernon J., Jr.** Influence of island migration on barrier-island sedimentation: Geol. Soc. America Bull., v. 78, no. 1, p. 77–86, illus., 1967.

Migrating barrier islands along coasts with a dominant longshore current have distinctive deposition characteristics. Channels between islands erode and redeposit sediments from associated environments and produce a change in textures, deposit shape, dip inclination, and bedding orientation. Channel deposits intertongue seaward with shallow neritic sediments and landward with salt-marsh sediments. Changes in sea level and sedimentation rates result in a variety of sediment-body shapes from shoestring to blanket deposits. Eight radiocarbon dates of Recent sediments from the margin of Sapelo Island, Ga., are included.—J.G.V.

9943 **Huddlestun, Paul F.** Facies changes within upper Eocene—basal Oligocene deposits in Alabama, *in* Facies changes in Alabama Tertiary—Alabama Geol. Soc., 4th Ann. Field Trip 1966, Guidebook: University, Ala., Alabama Geol. Soc., p. 41–42, 1966.

Two intertonguing lithosomes are recognized in this sedimentary sequence in Alabama: one clastic, typically developed in Mississippi and the western Gulf Coastal Plain; the other calcareous, typical of Florida, extending progressively westward through late Eocene time. There are two tongues of each lithosome, the constituent formations of which are named; their extent and relationships represent the fluctuation in supply of land derived sediments. In central Alabama there does not appear to have been any interruption in sedimentation or in kind of sedimentation at the end of Eocene time.—G.D.C.

9484 **Hughes, G. T.; Townsend, D. L.** Probe for measurement of pore water pressure in varved clays: Canadian Geotech. Jour., v. 3, no. 1, p. 46–50, illus., 1966.

A new probe is described for measuring pore-water pressure in varved clay samples during the consolidated-undrained test. The planes of the varves are perpendicular to the axis of the sample which is enclosed in a membrane. The probe is made from a No. 16 hypodermic needle bent 90° and fitted to a fine bore plastic tube leading to the pore pressure apparatus. Two or more probes are inserted through the probe patch and membrane to measure adjacent layers of the sample at the

same time. During the triaxial test, the probes proved capable of picking up the pore-water pressure accurately and quickly for pore-water pressures developed from 1 to greater than 100 lb/sq in.—V.M.J.

9602 **Hughes, George M.; Kraatz, Paul; Landon, Ronald A.** Bedrock aquifers of northeastern Illinois: Illinois Geol. Survey Circ. 406, 15 p., illus., table, 1966.

Ground water is obtained from four aquifer systems in northeastern Illinois—glacial drift, shallow bedrock, and two divisions of the deep bedrock. The main water-yielding unit of the shallow bedrock aquifer system is the Silurian dolomite; the main water-yielding units of deep bedrock aquifer systems are the Glenwood-St. Peter (Ordovician), Ironton-Galesville (Cambrian), and Mt. Simon (Cambrian) Sandstones. This report presents data on the thickness and distribution of the main water-yielding units in the shallow and deep bedrock aquifer systems. The maps and data are intended for use by well drillers and engineers concerned with ground-water development from the various aquifers and by local and regional organizations concerned with planning the use of the area's ground-water resources.—Authors' abstract

Huling, P. *See* Menzies, R. J. 9906

9521 **Hurr, R. Theodore; Richards, David B.** Ground-water engineering of the Straight Creek tunnel (pilot bore), Colorado: Eng. Geology, v. 3, nos. 1–2, p. 80–90, illus., table, 1966.

Occurrence of water-bearing zones in Precambrian granite and metamorphic rocks in the Straight Creek Tunnel pilot bore is directly related to fracture density. Rocks with joint spacing of 0.1–0.5 ft are major producers; those with spacing of 0.5–1 ft are secondary. Shear zones have closely spaced joints, and because of extensive alteration are much less permeable. The ground water found is in two zones—active and passive. Differentiation is based on changes in rate of discharge with season and tunnel station and on chemical quality. This study indicates that when driving new bores in similar areas, the tunnel should be portaled in late fall or early winter when discharge from the active zone is minimum, water pockets in the passive zone should be allowed to drain because of short discharge time; and the active zone and rock in the passive zone having joint spacings of 0.1 to 1 ft should be grouted.—M.S.T.

Hurst, Vernon J. *See* Crawford, Thomas J. 9790

9797 **Husain, L.; Kuroda, P. K.** Magnesium-28 in rain, produced by cosmic rays: Science, v. 154, no. 3753, p. 1180–1181, illus., table, 1966.

Existence of magnesium-28 (half-life, 21.3 hours) produced by cosmic rays in rain at concentrations of 1.7 and 6.1×10^{-1} atoms per milliliter was established radiochemically by isolating this nuclide from several hundred liters of rains samples collected at Fayetteville, Ark.—Authors' abstract

0045 **Illinois State Geological Survey.** List of publications, January 1967: Urbana, Ill., Illinois State Geol. Survey, 77 p., 1967.

Jambor, John L. *See* Skinner, Brian J. 9778

0084 **Jenke, Arthur L.** Case history of contamination control in Hubbard Creek Reservoir watershed, Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 169–170, 1967.

Johnson, J. G. *See* Boucot, A. J. 9751

Johnson, J. G. *See* Boucot, A. J. 9847

9551 **Johnson, Lane R.** Measurements of mantle velocities of P waves with a large array [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1513B, 1966.

9917 **Johnston, G. H.** A compact self-contained ground temperature recorder: Canadian Geotech. Jour., v. 3, no. 4, p. 246–250, illus., 1966.

A simple temperature-measuring device of reasonable accuracy, which will run unattended for a period of at least a year and operate at temperatures around O°F, has been developed by the Division of Building Research of the National Research Council of Canada. The two major components are a temperature-sensitive bimetallic strip and a battery-powered electric clock. The instrument and its field installation are described. Aside from ground temperatures, the instrument also can be used for measurement of lake bottom water temperature.—E.S.L.

9792 **Kaiser, Karlheinz.** Probleme und Ergebnisse der Quartärforschung in den Rocky Mountains (i. w. S.) und angrenzenden Gebieten [with English and French abs.]: Zeitschr. Geomorphologie, new ser., v. 10, no. 3, p. 264–302, illus., table, 1966.

In the Rocky Mts., distribution of structured soils is anomalous compared with other climatic geomorphologic height limits. During Quaternary the continental icecap extended across the mountains to the Pacific coast, with nunataks along the southern edge. Rivers on the Columbia Plateau were dammed forming lakes which later produced floods. In the southern Rockies, icecaps, plateau glaciers, and mountain glaciation occurred in northern and higher parts. Pleistocene snowline depression in the Pacific ranges is estimated at 1,000–1,300 m, in the continental Rocky Mts., 800–1,000 m, indicating increased continentality, leading to decreased temperature in the north, increased pluviality in the south, and other climatic geomorphologic height limits. Paleosols show four periods of glaciation.—E.S.L.

Kaiser, Karlheinz. *See* Rathjens, Carl. 9812

Karin, Mesbahul. *See* Aylmore, L. A. G. 0049

9926 **Kaula, William M.** Tests and combination of satellite determinations of the gravity field with gravimetry: Jour. Geophys. Research, v. 71, no. 22, p. 5303–5314, illus., tables, 1966.

Six solutions for the tesseral harmonics of the geopotential from satellite data were compared with gravimetry in the form of mean free-air anomalies of 300-nautical-mile squares. Statistical study showed significant variation in quality between different solutions, the best being that obtained recently from camera tracking of satellites by Gaposhkin (1966). The arithmetic mean of four independent satellite solutions was used with the gravimetry in an adjustment to obtain a single best solution, given here in the forms of a geoid map, spherical harmonic coefficients to degree and order 12,12, and gravity anomalies at 10° intervals.—D.B.V.

Keedy, Curtis R. *See* Haskin, Larry A. 9815

9772 **Kellogg, Remington.** Fossil marine mammals from the Miocene Calvert Formation of Maryland and Virginia—Pt. 3, New species of extinct Miocene Sirenia: U.S. Natl. Mus. Bull. 247, pt. 3, p. 65–98, illus., tables, 1966.

Geologic history and geographic distribution of the Sirenia is summarized, with emphasis on the American Dugongidae; taxonomy of the Tertiary dugongid genera *Felsinotherium* Capellini, *Halianassa* Studer, and *Metaxytherium* Christol is discussed. *Metaxytherium calvertense* n. sp., from the middle Miocene Calvert Formation, Calvert County, Md., is described in detail; the type specimen, collected in 1943 near Plum Point, is fairly complete, and there are 10 referred specimens. Miocene or Pliocene dugongid remains from dredged phosphate beds near Charleston, S. C., formerly known as *Dioplotherium manigaulti* Cope, 1883, are of two different size groups; it is suggested that the smaller be considered *Felsinotherium alleni* and the larger *Metaxytherium manigaulti*. *M. ortegense* n. sp. from the upper Miocene of Colombia is described.—V.M.J.

9773 **Kellogg, Remington.** Fossil marine mammals from the Miocene Calvert Formation of Maryland and Virginia—Pt. 4, A new odontocete from the Calvert Miocene of Maryland: U.S. Natl. Mus. Bull. 247, pt. 4, p. 99–101, illus., 1966.

Hadrodelphis calvertense n. gen. n. sp. is described from the middle Miocene Calvert Formation north of Governors Run, Md. The specimen consists of fused incomplete mandibles with some teeth in place. The teeth have no trace of accessory cusps or tubercles; they are larger and have relatively lower crowns than those of *Lophocetus pappus* from the Calvert (Kellogg, 1955). *Hadrodelphis* is distinguished from two other middle Miocene delphinids: *Macrodelphinus kelloggi*, California (L. E. Wilson, 1935), by fewer and larger teeth, much larger and more widely spaced alveoli, thicker mandibular rami; and *Megalodelphis magnidens*, Florida (Kellogg, 1944), by much narrower mandibular symphysis and much narrower interspaces between alveoli.—V.M.J.

Kemper, W. D. *See* Shainberg, I. 0053

9489 **Kenney, T. C.** Identification and performance of swelling soil types [discussion of paper by R. M. Hardy, 1965]: Canadian Geotech. Jour., v. 3, no. 3, p. 167–168, 1966.

Hardy has modified the principle of effective stress (ibid., v. 2, no. 2, p. 141–153, 1965) to include a swelling pressure term P_s, where P_s is the pressure required to prevent a soil sample from swelling. The effective stress equation becomes $\sigma^1 = \sigma - u - P_s$, where u is pore-water pressure and σ is overburden pressure. This modification is unacceptable. In a test performed *in situ*, the soil element will be in equilibrium with the vertical stress. It must be concluded that the result would be swelling pressure equal to the overburden pressure, that is $P_s = \sigma - u$. Using the modified equation, the effective vertical stress σ^1 acting on the soil element is equal to 0. The argument can be applied to any soil in chemical equilibrium under any condition of stress and yields the same result that $\sigma^1 = 0$.—B.S.H.

Kerr, Paul F. *See* Hausen, Donald M. 9676

9893 **Kesling, Robert V.** Cyclocystoids, *in* Treatise on invertebrate paleontology—Pt. U, Echinodermata 3, V. 1: New York, Geol. Soc. America (and Univ. Kansas Press), p. U188–U210, illus., table, 1966.

The Cyclocystoidea are a class of small disc-shaped, apparently free-living, echinoderms, restricted to the lower Paleozoic, of which the parts other than the ring of submarginal plates are usually poorly preserved. About 21 valid species are assigned to a single genus, *Cyclocystoides*, but some of these may be growth stages of the same species. The cyclocystoids were formerly classed as Pelmatozoa, because of the general resemblance of the ambulacral system to that of cystoids. They are here transferred to the Echinozoa because they resemble edrioasteroids in the thickness of the submarginal plates, and the apparent attachment, by suction, of the aboral disk to the substrate. A primitive diploporitan cystoid with a broad-based theca is suggested as a possible ancestor.—V.M.J.

Kier, P. M. *See* Durham, J. Wyatt. 9894

King, E. R. *See* Zietz, Isidore. 9775

Kirkemo, Harold. *See* MacLaren, D. R. 9671

9590 **Kirtley, David W.** Intertidal reefs of Sabellariidae (Annelida Polychaeta) along the coasts of Florida: Coastal Research Notes, v. 2, no. 3, p. 7, 1966.

A survey of 42 localities was made to examine the occurrence and distribution of reef-building polychaetous annelids. Large reefs constructed by *Phragmatopoma labidosa* were found in the intertidal zone and shallow foreshore areas from Key Biscayne to Port Canaveral. Other members of the family are reported north of Cape Kennedy to the Georgia line, but do not build reefs. On the Gulf side, *Sabellaria floridensis* has built reefs along Franklin County. These worms depend on turbulent water, and fill in for the corals where they cannot live. The reefs control sedimentation and coastal evolution.—E.S.L.

0079 **Klement, Karl W.** Practical classification of reefs and banks, bioherms and biostromes [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 167–168, 1967.

0043 **Klinger, Robert R.; Ash, Richard D.** Geologic studies can project stratigraphic trap trends: World Oil, v. 164, no. 2, p. 65–70, illus., 1967.

Stratigraphic traps in rocks of Chester (Mississippian) and Morrow (Pennsylvanian) age in the Anadarko basin, Oklahoma, result from truncation of strata beneath unconformities and depositional variations in sediments on the basin hingeline and shelf. In exploration, trends for potential stratigraphic traps are best determined through analysis of detailed cross sections, structure, and isopachous maps. Illustrated examples are presented.—M.W.R.

9916 **Klohn, E.** Elastic properties of a dense glacial till deposit [closure to discussions of 1965 paper]: Canadian Geotech. Jour., v. 3, no. 4, p. 235–239, illus., 1966.

The net effect of load removal on measured rebound values is thought to be small because the unloading-process was slow, no long-term rebounds were noted, and pre-construction pore-water pressures were large. Piezometer readings adjacent to the spillway excavation show little reaction to the excavation until it went below river level. Klohn has no empirical data that permit a direct evaluation of EH/EV value for the till, but believes it is near unity. A typical test-hole log from the spillway area is included. The hope is expressed that additional case histories relating to in situ modulus elasticity values will be published. (Original paper, ibid., v. 2, no. 2, p. 116–128, 1965.)—E.S.L.

9749 **Klovan, J. E.** Upper Devonian stromatoporoids from the Redwater reef complex, Alberta [with French abs.]: Canada Geol. Survey Bull. 133, p. 1–32, illus., tables, 1966.

Stromatoporoids are the dominant reef builders in the Redwater reef complex of Alberta. Twenty-seven species comprising thirteen genera are described and illustrated from specimens collected from cores of the Upper Devonian Leduc Formation at Redwater field. Descriptions of a new genus, *Euryamphipora*, and six new species are included.—B.S.H.

9923 **Knowles, J. K.** A note on elastic surface waves: Jour. Geophys. Research, v. 71, no. 22, p. 5480–5481, 1966.

The structure of harmonically time-dependent free surface waves on a homogeneous isotropic elastic half space is described, proceeding from the assumptions that the plane boundary is free of surface traction and that the Lamé potentials, and consequently all physical quantities, decay exponentially with distance away from the boundary; in the absence of further assumptions the resulting surface waves need be neither plane nor axially symmetric, and thus the derivation sketched here constitutes a generalization of the ones usually given in textbooks.—D.B.V.

9552 **Knox, Burnal Ray.** Pleistocene and Recent geology of the southwest Ozark plateaus [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1514B, 1966.

9540 **Ko, Hon-Yim.** Static stress-deformation characteristics of sand [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1470B, 1966.

9747 **Koch, Neil C.** Ground water in the crystalline rock area in South Carolina: South Carolina Div. Geology Geol. Notes, v. 10, no. 3, p. 37–41, illus., 1966.

The crystalline rocks of South Carolina are an important source of water, not because of very large yields, but because they are widespread and can provide yields sufficient for homes, farms, and small businesses. The most important conditions for well-site selection are rock type and topography. In general schist has the highest yields although wells in granite and gneiss that are located in valleys and on slopes frequently have higher yields; the amount of fracturing also plays an important part. In granite the largest yields can be expected in the first 25 to 50 feet as fractures tend to decrease with depth. Because fractures are more persistent in gneiss and

schist high yields can occur down to 300 feet. Good yields also can be expected at the contacts of different rock types.—B.S.H.

9825 **Kono, M.; Nagata, T.** Intensity of the geomagnetic field during a reversed polarity: Nature, v. 212, no. 5059, p. 274–275, illus., 1966.

It has been found that the technique of demagnetization by stepwise heating, used in archeomagnetic determinations of the intensity of past geomagnetic fields, can also be applied to rocks more than a million years old. Results of such determinations on 24 samples of K–Ar dated Pliocene basalts from Taos, N. Mex., and Flagstaff, Ariz., strongly support the theory that the intensity of the reversed magnetic field 3–4 m.y. ago in the southwestern United States was of similar magnitude to that of the succeeding normal field and also to that of the present geomagnetic field.—D.B.V.

Kraatz, Paul. *See* Hughes, George M. 9602

9527 **Krajina, Vladimir J.** Biogeoclimatic zones of the Hawaiian Islands and their variation by volcanic activities [abs.], *in* Abstracts of papers related with biology—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 5: Tokyo, Sci. Council Japan [Sec. 3], p. 1, 1966.

9638 **Králík, Jirí; Misík, Milan.** Authigenic feldspars from the baryte concretion from the Tertiary of Cuba: Slovensk. Akad. Vied Geol. Sborník, v. 17, no. 1, p. 105–116, illus., 1966.

Authigenic feldspar has been identified in barite concretions from the Consuelo Formation (Oligocene) exposed in a quarry in the Havana area. Both the concretions and the feldspar (labradorite) are considered diagenetic in origin. Formation of the feldspar may have occurred as late as the Miocene.—M.S.

0104 **Kruger, C. L.** (compiler). Aeromagnetic map of the Perch Lake quadrangle, Houghton, Baraga, and Iron Counties, Michigan: U.S. Geol. Survey Geophys. Inv. Map GP–600, scale 1:62,500, 1967.

0068 **Krutak, Paul R.** Structural geology of the Sierra de la Gavia, Coahuila, Mexico: Geol. Soc. America Bull., v. 78, no. 1, p. 59–75, illus., geol. maps, 1967.

Sierra de la Gavia is one of a number of northwesterly alined mountain-forming anticlinal structures in northeastern Mexico. The fold rises abruptly out of bolson plains which border its northeast and southwest flanks. The fold is doubly plunging—to northwest and southeast—but mapping discloses five separate areas of closure. The fold is formed mainly in Lower Cretaceous rocks about 7,000 feet thick. Large-scale drag folding modifies both flanks of the fold in some areas. This fold and similar structures in the region may have resulted from recurrent movement along a suggested large wrench fault.—J.P.A.

9669 **Kulm, L. D.; Byrne, John V.** Sedimentary response to hydrography in an Oregon estuary: Marine Geology, v. 4, no. 2, p. 85–118, illus., tables, 1966.

In the various estuarine environments of Yaquina Bay, analyses of sediment texture and mineralogy reveal within the bay two major realms of deposition, marine and fluviatile, and a third marine–fluviatile transition realm. The marine realm extends 1.5 miles into the entrance of the estuary; its well-sorted, fine–medium sands are typified by diagnostic heavy minerals, and texturally similar to sands of the adjacent beaches and coastal dunes. The fluviatile realm occurs from the fresh-water head to a point six miles from the bay entrance; its sediments range in grain size from silt to coarse sand with fluviatile heavy minerals. The sediments are derived from Tertiary rocks of the central Oregon Coast Range, Pleistocene marine terrace and estuarine deposits near the bay mouth, and Recent beach and dune sands that flank the bay entrance.—G.D.C.

Kuroda, P. K. *See* Husain, L. 9797

9818 **Kushiro, I.; Yoder, H. S., Jr.** Anorthite–forsterite and anorthite–enstatite reactions and their bearing on the basal–eclogite tresformation: Jour. Petrology, v. 7, no. 3, p. 337–362, illus., tables, 1966.

Reactions between anorthite and forsterite and between anorthite and enstatite have been studied at high pressures and temperatures. Results suggest that basalts, either saturated or undersaturated with silica, transform into aluminous pyroxene–rich assemblages at lower pressures or higher temperatures than the stability field of eclogites, and that pyroxene–spinel symplectites found in some metamorphosed gabbro, troctolite, and norite may have formed in the stability field of pyroxene–rich assemblages. The stability field of the pyroxene–rich assemblages is probably included within the pressure–temperature conditions of the granulite facies. Also garnet–free peridotites are stable at lower pressures or higher temperatures than garnet peridotites.—*from* Authors' abstract

9727 **Lacy, R. J.; Morrison, B. C.** Case history of integrated geophysical methods at the Mission deposit, Arizona, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 321–325, illus., 1966.

The Mission Mine is an ASARCO open pit operation on a large copper deposit 20 mi south–southwest of Tucson, Ariz. It was discovered under ±200 feet of alluvium by an integrated geological–geophysical program. Magnetics and gravity indicated suboutcrops of post–mineral versus premineral rocks. Magnetics indicated local zones of particularly high magnetite content and gravity indicated the heavy lime–silicates associated with ore grade mineralization. Electromagnetics indicated complex conductors consisting of interconnected sulfide veinlets and lenses. Induced polarization outlined and defined the concentrations of sulfides.—Authors' abstract

Lamay, William J. *See* Gratton, Patrick J. K. 0085

9660 **Land, Lynton Stuart.** Diagenesis of metastable skeletal carbonates [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1514B, 1966.

Landon, Ronald A. *See* Hughes, George M. 9602

9865 **Lane, N. Gary; Webster, G. D.** New Permian crinoid fauna from southern Nevada: California Univ. Pubs. Geol. Sci., v. 63, 60 p., illus., 1966.

Crinoids of middle Wolfcampian Age from the Bird Spring Formation in the Arrow Canyon Range, Clark County, Nev., constitute the largest known Permian crinoid fauna in the western hemisphere. Among 28 figured taxa are three genera of flexible crinoids including two new genera: *Nevada crinus and Trampidocrinus*. Inadunates are represented by 20 genera, three of which are new: *Arroyocrinus, Moapacrinus, and Celonocrinus*. All of the inadunate species are new. Seven crinoid genera are recorded for the first time from post–Pennsylvanian strata.—W.O.A.

9782 **Langill, F. E.** Bibliography of seismology, Items 18999–19426, September–December, 1964: Dominion Observatory Ottawa Pubs., v. 30, no. 6, p. 185–208, 1966.

The Bibliography of Seismology will cease publication with this number. The International Seismological Research Centre, Edinburgh, Scotland, intends to continue a seismological bibliography beginning with material for 1965 and using a keyword–in–context index. This number continues the policy of listing each paper only once and using author and subject indexes.—E.S.L.

9670 **Langseth, Marcus G., Jr.** Review of heat flow measurements along the Mid–Oceanic Ridge system, *in* The world rift system—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66–14, p. 349–363, illus. [1966].

More than 350 heat flow measurements, made in the vicinity of the Mid–Oceanic Ridge, show great variability both locally and regionally. Crests of the Mid–Atlantic and Mid–Indian Ocean Ridges and East Pacific Rise, show higher than normal heat flow; flanks of the first two have values somewhat below the mean of all values,

and the overall average for both is close to the world mean value. However, the overall average along the East Pacific Rise is well above the mean.—E.S.L.

9925 **Langseth, Marcus G., Jr.; LePichon, Xavier; Ewing, Maurice.** Crustal structure of the mid-ocean ridges—[Pt.] 5, Heat flow through the Atlantic Ocean and convection currents: Jour. Geophys. Research, v. 71, no. 22, p. 5321–5355, illus., tables, 1966.

One hundred and seventy-nine Lamont Geological Observatory heat-flow measurements in the Atlantic Ocean and the Caribbean Sea are presented; their reliability is carefully estimated. Together with 197 other measurements, they are used to describe the broad regional pattern of heat flow in the Atlantic Ocean. The average heat flow over the mid-Atlantic ridge is within 20 percent of the heat flow of the basins, and the absence of a wide heat-flow maximum in the observed values precludes the possibility of continuous continental drift during the Cenozoic by the spreading-floor mechanism in the Atlantic Ocean. In contrast, the excess of heat flow measured over the East Pacific rise is consistent with the existence of large convective transfer of heat in the underlying mantle.—Authors' abstract

0060 **Laporte, Leo F.** Carbonate deposition near mean sea-level and resultant facies mosaic—Manlius Formation (Lower Devonian) of New York State: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 73–101, illus., tables, 1967.

The Manlius Formation was deposited near mean sea-level over a very large area with low relief. Three carbonate facies are recognized: a supratidal, slightly above mean sea-level, characterized by nonfossiliferous, laminated, mudcracked, dolomitic, pelletal, carbonate mudstone, with thin bituminous films separating individual laminae suggesting algal mats; an intertidal, at mean sea-level, characterized by alternating thin beds of sparsely fossiliferous pelletal, carbonate mudstone and skeletal calcarenite, and scour-and-fill, cross-stratification, limestone-pebble conglomerate and rare mudcracks; and a subtidal facies, below mean sea-level, characterized by a skeletal, pelletal, carbonate mudstone with well developed, tabular masses of stromatoporoids and solitary rugose corals, favositids, ostracods, strophomenid brachiopods, loxonematid snails, and a codiacean alga.—S.P.S.

9553 **Larimer, John William.** The petrology of chondritic meteorites in the light of experimental studies [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1515B, 1966.

9793 **Larochelle, A.; Wanless, R. K.** The paleomagnetism of a Triassic diabase dike in Nova Scotia: Jour. Geophys. Research, v. 71, no. 20, p. 4949–4953, illus., tables, 1966.

The paleomagnetism of a 110-km-long diabase dike in the southern part of Nova Scotia has been studied. A potassium-argon whole-rock age determination has confirmed the Triassic age assignment to the dike rocks. The magnetic stability and other magnetic properties of the rocks were examined, and the presence of a stable component was established. An analysis of the paleomagnetic data establishes their statistical significance and indicates that at the time of injection of the dike the North Pole was situated in the area presently occupied by northern Siberia (98° E., 69° N.). This pole position is in good agreement with available paleomagnetic poles obtained for other North American Triassic formations.—Authors' abstract

9827 **Larson, Edwin E.; Strangway, David W.** Magnetic polarity and igneous petrology: Nature, v. 212, no. 5063, p. 756–757, illus., 1966.

It is shown that there is no correlation between igneous petrology and magnetic polarity in young volcanic rocks when sampling is carried out on a comprehensive basis and when magnetically unstable samples are rejected. Limited sampling could lead to an apparent correlation because superimposed lavas of opposing polarity are also of different age, and could have a different petrology. The inclusion of unstable samples would also lead to an apparent correlation, as these samples are probably magnetized in the present field.—D.B.V.

Lautman, Don A. *See* Colombo, Giuseppe. 9834

Lautman, Don A. *See* Shapiro, Irwin I. 9838

Lautman, Don A. *See* Colombo, Giuseppe. 9839

9840 **Lautman, Don A.; Shapiro, Irwin I.; Colombo, Giuseppe.** The Earth's dust belt, fact or fiction?—[Pt.] 4, Sunlight-pressure air-drag capture: Jour. Geophys. Research, v. 71, no. 23, p. 5733–5741, illus., tables, 1966.

An investigation of the contribution to the Earth's dust belt that stems from the trapping of particles into long-lifetime bound geocentric orbits by the combined action of air drag and sunlight pressure shows that if the speed of a substantial fraction of the dust particles entering the Earth's sphere of influence is ≤ 1 kmps, the dust-particle flux will exhibit a broad peak at an altitude of about 0.5 earth radii and will be of the order of 10^2 or more times greater than the flux at the boundary of the Earth's sphere of influence. A more realistic initial distribution of dust-particle orbits lends little support to the supposition that the Earth is a very effective entity for concentrating interplanetary dust particles.—D.B.V.

9939 **LaValle, Plácido.** Variación espacial de la karstificación relativ en Kentucky sur-central, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 267–276, illus., 1966.

From a quantitative geomorphic analysis of 800 sq mi of south-central Kentucky, underlain by Mississippian limestones, it is found that karst is dominant in very pure and dense St. Louis and St. Genevieve Limestones of the Plateau Province, and sporadic in thinly alternating clastic formations north of Dripping Springs Escarpment and in the argillaceous Warsaw and Fort Payne Formations on the southeast. Measures reflecting degree of karst development are examined for spatial variations related to lithology, structure, geometry of karst drainage, and relative location in the erosional pattern. These relations are then integrated with a series of theoretical models which explain variations in landscape; 76 percent of the spatial variations in solution texture and 72 percent of those in amount of relief are influenced by these factors.—G.D.C.

Lavin, P. M. *See* Ross, H. P. 9740

9579 **Lawrence, E. F.; Wilson, W. L.** Exploration of the Hottentot prospect, Walker River Indian Reservation, Nevada, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. A: Nevada Bur. Mines Rept. 13, pt. A, p. 143–158, illus., 1966.

Except for a small exposure of diorite near outcropping magnetite, and two slivers of associated metamorphic rocks of Mesozoic age, the Hottentot prospect is overlain by Cenozoic volcanics intruded by mafic plugs, and lacustrine deposits of Lahontian age. Drill-hole samples indicate underlying granitic rocks, highly silicified and somewhat albitized in the area of mineralization, chloritic and argillic away from it. Strike-slip faulting begun in late Mesozoic time may still be active. An aerial magnetic survey gave about the same picture as a detailed ground magnetic survey except for missing a small anomaly in the southeast, where drilling through 177 feet of tuff encountered high-grade magnetite-hematite for a thickness of 177 feet. Other geophysical methods have problems in this area of polarized volcanic rocks and disseminated conductors.—G.D.C.

9903 **Lehmann, Inge.** On the structure of the upper mantle: Seismol. Soc. America Bull., v. 56, no. 5, p. 1147–1152, illus., table, 1966.

From apparent velocities of first arrivals across the Tonto Forest array for epicentral distances from 11° to 29°, Niazi and Anderson [1965] derived a structure of the upper mantle deviating markedly from other structures as determined of late. It is found that on a different interpretation their data are in good accord with the Lehmann structure of the upper mantle.—Author's abstract

Leinhardt, T. E. *See* Robbins, Thomas. 9528

9744 **Leonards, G. A.** Settlement of a mat foundation on a thick stratum of sensitive clay [discussion of paper by L. Casagrande and others, 1965]: Canadian Geotech. Jour., v. 3, no. 2, p. 100–102, table, 1966.

Casagrande and others (ibid., v. 2, no. 4, p. 299–312, 1965) have presented a well-documented case record comparing calculated vs. observed settlements for a major structure on Leda clay, St. Lawrence River east of Montreal. These suggestions are made: (1) Magnitude of the recompression index C_r obtained from the rebound portion of the pressure vs. void ratio curve may have been overestimated. (2) Use of small load increments is helpful when determination of preconsolidation pressures is critical, but with too small an increment the time curve cannot be interpreted. (3) The immediate settlement was not estimated; results for five possible values of Young's modulus are here tabulated. (4) Apparent discrepancies in drop in river level and ground-water level used in the settlement analysis are noted. An alternate explanation for the observed settlements is proposed.—V.M.J.

Leopold, Estella B. *See* Easterbrook, Donald J. 0013

LePichon, Xavier. *See* Langseth, Marcus G., Jr. 9925

9931 **Liberty, B. A.** Geology of the Bruce Peninsula, Ontario: Canada Geol. Survey Paper 65–41, 8 p., table, geol. maps, 1966.

Upper Ordovician, Silurian, and Middle Devonian rocks on the Bruce Peninsula are subdivided into 13 map-units. Brief, lithic descriptions and nomenclature of the formations are presented. Thirteen two-tone geologic maps on the scale of 1 inch to 1 mile accompany the report.—Author's abstract

9675 **Lickus, Robert J.** Variation of copper–zinc ratios in the ore deposits of the Vauze mine, Noranda district, Quebec [abs.]: Econ. Geology, v. 61, no. 8, p. 1469, 1966.

Lidiak, E. G. *See* Zietz, Isidore. 9775

Lidiak, Edward G. *See* Goldich, Samuel S. 9765

Lidiak, Edward G. *See* Goldich, Samuel S. 9766

9767 **Lidiak, Edward G.; Marion, Richard F.; Thomas, Herman H.; Bass, Manuel N.** Geochronology of the midcontinent region, United States—[Pt.] 4, Eastern area: Jour. Geophys. Research, v. 71, no. 22, p. 5427–5438, illus., table, 1966.

The Precambrian basement rocks of Iowa, Illinois, Indiana, Ohio, and adjacent areas have had a complex history of metamorphism, plutonism, and volcanism. Iowa is underlain by a gneiss-schist-granite complex dating from the Penokean orogeny (1,600–1,800 m.y.), intruded by gabbroic rocks at least 1,300 m.y. old. Other dates include Keewanawan sedimentary and igneous rocks in Iowa (1,100 m.y.); granites in Iowa, Illinois, and Indiana at least 1,350 m.y. old; rhyolite and trachyte in western Ohio 1,260 m.y. old; and Keweenawan granite in Indiana, about 1,100 m.y. old. Mica ages for the basement in Ohio are similar to those for the Grenville province of Canada.—D.B.V.

9901 **Livingston, Vaughn E., Jr.** Geology and mineral resources of the Kelso–Cathlamet area, Cowlitz and Wahkiakum Counties, Washington: Washington Div. Mines and Geology Bull. 54, 110 p., illus., tables, geol. maps, 1966.

The Kelso–Cathlamet area is underlain by rocks ranging in age from Eocene to Recent. Volcanics and lava flows form parts of the Eocene, Oligocene, and Miocene sections. Pliocene rocks are restricted to conglomerates, and Pleistocene and Recent materials are unconsolidated sand, gravel, and landslide debris. Predominant structural trends are to the northwest; folds of less magnitude trend east-west. Dips are low, faults are common. Mineral deposits consist of ferruginous bauxite, coal, stone, sand and gravel, and peat. The bauxite appears to have the greatest potential for development; it averages about 38 percent Al_2O_3, 6 percent SiO_2, 27

percent Fe_2O_3, and 4 percent TiO_2 through the ore zone, which averages about 12 feet in thickness.—*from* Author's abstract

9483 **Lo, K. Y.; Stermac, A. G.** Failure of an embankment founded on varved clay [reply to discussions following original paper, 1965]: Canadian Geotech. Jour., v. 3, no. 1, p. 42–45, illus., 1966.

Discussions of the original paper (ibid., v. 2, no. 3, p. 234–253, 1965) centered on problems of evaluation of the undrained strength and strength parameters in terms of effective stresses of varved clays. It is shown that field vane tests only appear by coincidence to continue the curve defined by unconsolidated-undrained test results. Unconfined-compression test results lie below the UU-curve but follow the same trend. Probably the in situ vane test represents the upper limit while the unconfined-compression tests from borehole samples represent the lower limit of the undrained strength in varved clays. Use of a finite value of C′ in effective stress analysis was questioned; use of a small C′ is justified because, while the applied load does exceed the overconsolidation pressure at most points, the effective stresses at the moment of failure are still within the preconsolidation range.—V.M.J.

9892 **Löken, Olav K.** Glaciología y geomorfología del extremo sur de la capa de hielo de Barnes, *in* Unión Geog. Internac. Conf. Regional Latinomaericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 155–176, illus., tables, 1966.

Investigations of the Barnes icecap included measure of mass balance on the cap itself and analysis of aerophotographs of glacial deposits in the adjacent area; both revealed distinctive contrasts between margins northeast and southeast of the icecap. There is evidence that the south end of the icecap has been subject to change in the recent past; however, results suggest that the icecap has outlived the last glaciation. Although preliminary, the investigations have shown interesting results in relation to the history and actual behavior of the Barnes icecap. A complete understanding of the problems would require more investigations related to mass balance, ice movement, and geomorphology of the adjacent area.—G.D.C.

Lotspeich, F. B. *See* Clyma, Wayne. 9841

9576 **Love, W. H.** The Ruby Hill project, Eureka, Nevada, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. A: Nevada Bur. Mines Rept. 13, pt. A, p. 85–107, illus., 1966.

Exploration drilling and mining in the Eureka lead-silver district met problems in the ever deeper search in the Ruby Hill fault zone, especially with water flooding. A history of development since 1864, when ores were discovered near Eureka, is given. After a new program embracing drilling from the surface was completed in 1960, an ore reserve estimate of about 2,500,000 tons assaying 0.216 oz gold per ton, 8.85 oz silver per ton, 6.45 percent lead, and 11.45 percent zinc was computed. Decision made to seal off water at the 2250-level drift, by pressure-grouting cementation in the Martin fault area, met limiting factors of tight fractures and fissures with gouge in the Eldorado dolomite and incompetent Secret Canyon shale above for collaring the holes.—G.D.C.

9703 **Lovell, Howard.** Terry township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 365, scale 1 in. to 1/4 mi., text, 1966.

All outcrops in Terry township are Precambrian granitic rocks and diabase; the granitic rocks form part of the Watabeag Lake batholith and are cut by diabase. Glacial fluting to the east indicates ice movement from N. 10° W.; parabolic sand dunes covering most of the western and central areas indicate that during early post-glacial times, prevailing wind was WNW. The most prominent structure is a lineament along Tolstoi Creek and Red Lake; aeromagnetic relief is relatively flat with contours trending north. There has been no thorough prospecting because most of the bedrock is granitic, but rocks near the quartz vein south of Fallduck Lakes should be prospected for molybdenite.—M.C.M.

Luce, Philip B. *See* Foster, Roy W. 9622

9554 **Lucier, Wallace Anthony.** The petrology of the Middle and Upper Devonian Kiskatom and Kaaterskill Sandstones—A vertical profile [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1515B, 1966.

Ludwig, C. S. *See* Heinrichs, Walter E., Jr. 9725

9739 **Lumb, Peter.** The variability of natural soils [with French abs.]: Canadian Geotech. Jour., v. 3, no. 2, p. 74–97, illus., tables, 1966.

Variations in properties of four typical natural soils are shown to be random variations about a mean or linear trend, related to the normal or Gaussian statistical distribution. Examples are given of soil properties following the normal, log normal, and bi-normal distributions. Properties studied include Atterberg limits, grading, and strength and compressibility characteristics. A basis for choice of a design parameter is the probability that the parameter could be less than the design value. For any particular probability the design parameter can be determined using normal distribution. In estimates of bearing capacity, an analysis of the conventional factor of safety suggests a suitable value of probability of the order of 10^{-2} to 10^{-3} percent. In estimates of settlement, upper and lower bounds to magnitude and rate can be associated with a particular probability or risk.—*from* Author's abstract

9649 **Lutz, J. A., Jr.** Ammonium and potassium fixation and release in selected soils of southeastern United States: Soil Sci., v. 102, no. 6, p. 366–372, illus., tables, 1966.

Although the soils used from the southern United States varied widely in clay mineralogy, percentage of clay, and organic matter, the release of both NH_4 and K was related mainly to the amount of NH_4 and K fixed.—J.W.H.

9492 **Lynch, John D.** Additional treefrogs (Hylidae) from the North American Pleistocene: Carnegie Mus. Annals, v. 38, art. 11, p. 265–271, illus., table, 1966.

Fossil hylids are recorded from Pleistocene deposits of Maryland, Pennsylvania, Tennessee, and Texas. *Hyla crucifer, Pseudacris streckeri, and P. triseriata* are reported as fossils for the first time. A new species, *Hyla holmani*, is described from the Wisconsin (Pleistocene) deposits of Hardeman County, Tex. *Acris crepitans and Hyla femoralis* are also reported, representing Pleistocene range extensions.—*from* Author's summary

9689 **Macdonald, J. R.** Dig that horse heaven: Los Angeles County Mus. Nat. History Quart., v. 5, no. 2, p. 12–14, illus., 1966.

There is a great deposit of late Pliocene horse remains on the west side of the Snake River in Idaho, across from Hagerman. The fossils are dated by a lava flow just below the quarry, which has a K–Ar age of 3.5 m.y. The river here follows the line of contact of lava flows on the east and water-borne sediments on the west. With melting glaciers and runoff from Lake Bonneville, the Snake cut a deep canyon and exposed the fossils. The work of the Los Angeles Museum personnel in excavating their collection is described.—E.S.L.

9591 **Machek, Annette.** A study of deposition in the surf zone on a low energy coastline: Coastal Research Notes, v. 2, no. 3, p. 11–12, table, 1966.

Twelve samples were taken from St. George Island, Fla., six from the beach facing the Gulf, and six from that facing Apalachicola Bay. Sampling was done by sinking coffee cans, one at the position of maximum swash, one at the beach toe, and one halfway between. One sample was taken from the top of each can and another half-way down. Filling time was much longer on the Bay side. Samples contained quantities of shell material, and frequency curves show coarser material deposited at the toe and finer at the swash. Samples from the toe in the two areas were more nearly similar than from the other positions.—E.S.L.

Machin, D. J. *See* Carmichael, I. S. E. 9771

9671 **MacLaren, D. R.; Weissenborn, A. E.; Weis, P. L.; Kirkemo, Harold.** Gold, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 82–92, illus., table, 1966.

Although gold was first discovered in Washington in 1853, production has been greatest during the last 20 years, and since 1957 it has ranked from 5th to 7th among gold-producing States. A summary of the lode gold districts are given in a table. The history of gold mining and the geology, distribution, and occurrence are included in this report.—W.L.G.

0016 **Maclay, R. W.; Winter, T. C.** Geochemistry and ground-water movement in northwestern Minnesota: Ground Water, v. 5, no. 1, p. 11–19, illus., 1967.

Lateral and vertical variations of water quality in the ground-water reservoir reflect difference in length of flow paths within the system. Relative concentration of major ions in solution changes as water moves from recharge to discharge areas. These changes are used to interpret direction and rate of ground-water movement. Ground-water types mapped in the Two Rivers watershed of Minnesota indicate that calcium bicarbonate type occurs near the source of recharge and progressively changes to sulfate type as water moves down gradient toward the discharge area. Calcium bicarbonate type water of streams during low flow indicates that water moves into the stream from the upper ground-water reservoir. Chloride type water moves from Paleozoic rocks and mixes with water in glacial drift probably at places where permeable zones in Paleozoic rocks are in contact with overlying drift.—*from* Authors' abstract

9860 **Maderey R., Laura Elena.** Mapa geohidrológico de México, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 423–435, illus., 1966.

Based on principles adopted from Meinzer (1925) and factors suitable for the presence of ground water, as indicated on given maps of precipitation, physiography, geology, and vegetation, Mexico is divided into 14 hydrogeologic regions: north, central, and southern zones of Baja California; northern high plains and Pacific coastal plains; Sierra Madre Occidental and cross ranges of volcanic rocks; coastal plains of Sinaloa, Nayarit, and part of Sonora; Sierra Madre Oriental and zone northeast of the high plains, chiefly Cretaceous limestones; Gulf of Mexico coastal plain; Sierra Volcánica Transversal and south of the high plains; Sierra Madre del Sur and Pacific coastal zones of nearby states; Balsas-Tepalcatepec basin; zone southeast of México; Sierra Madre and coast of Chiapas; and Yucatán Peninsula.—G.D.C.

9722 **Maillot, E. E.; Sumner, J. S.** Electrical properties of porphyry deposits at Ajo, Morenci, and Bisbee, Arizona, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 273–287, illus., tables, 1966.

A field study of electrical properties of rocks was made in three open pit mines to determine the relation between induced-polarization anomaly magnitude and percent metallic minerals. Mineralization was exposed so that nearly true values were measured. Sulfide content ranged from 2 to 10 percent by volume. The frequency effect was rather constant, varying between 14 and 17 percent, so PFE alone would not be a good guide to metallic mineral content. Resistivity is interpreted to reflect rock porosity rather than mineralization at these low sulfide contents. The direct relation between sulfide content and resistivity cannot be used as an exploration guide because of common occurrence of low resistivities in unmineralized rocks elsewhere. It is concluded that the metal factor can be used in interpreting results of induced polarization for estimating amount of mineralization.—*from* Authors' abstract

Maleki, M. *See* Fatt, I. 9708

9854 **Manum, Svein.** *Ginkgo spitsbergensis* n. sp. from the Paleocene of Spitsbergen and a discussion of certain Tertiary species of *Ginkgo* from Europe and North America: Norsk Polarinst. Årb. 1965, p. 49–58, illus., 1966.

Ginkgo spitsbergensis n. sp. is described on new material from the Paleocene of Spitsbergen, with particular regard to its epidermal characters. Probably all the older finds of *Ginkgo* in the Spitsbergen Tertiary should be referred to the new species. The epidermal characters of *G. wyomingensis* n. sp. from the Paleocene of North America are also described. The two new species are compared in detail with the previously best known Tertiary species, *G. adiantoides* (Ung.) Heer emend. Florin and *G. gardneri* Florin.—Author's abstract

Maras, Burhanuddin B. *See* Foster, Roy W. 9622

Marion, Richard F. *See* Lidiak, Edward G. 9767

0044 **Marti, Kurt.** Mass-spectrometric detection of cosmic-ray-produced Kr^{81} in meteorites and the possibility of Kr-Kr dating: Phys. Rev. Letters, v. 18, no. 7, p. 264–266, tables, 1967.

Kr-81, the first detected cosmic-ray-produced radioactive nucleus heavier than the Fe-Ni group, was found to be present in meteorites. The radiation age of the Macibini meteorite is calculated from the measured isotopic composition of krypton. This dating method should be applicable to most stone and stony-iron meteorites.—Author's abstract

9645 **Martin, Paul S.** Africa and Pleistocene overkill: Nature, v. 212, no. 5060, p. 339–342, illus., tables, 1966.

The extinction of 35 genera of large mammals and one of reptiles characterizing the late Pleistocene of North America has been attributed to the arrival of prehistoric hunters. The African game plains presently contain only about 60 percent of the genera of large mammals encountered in the hand-axe faunas, and thus the inference that there was no extinction in the late Pleistocene of Africa, cited as evidence against the hypothesis of culturally caused extinction in the New World, must be rejected. Until a place can be found where Pleistocene megafaunal extinction clearly predates the arrival of man, the overkill hypothesis stands unrefuted on chronological grounds.—D.B.V.

9905 **Martin-Kaye, P.; Badcock, J.** Geological background to soil conservation and land rehabilitation measures in Barbados, W. I., *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 131–135, illus., 1966.

Geologic factors play a pronounced role in soil and land conservation problems in the Scotland District of Barbados. The Paleocene-Pleistocene stratigraphy is reviewed, and water-bearing character of the formations discussed. Springs flowing from the surrounding escarpment keep susceptible formations in a state of instability. The Coral Rock Formation forms a rigid cap above the pliable beds, and segments have slid and crept downhill, some reaching the sea. Attempts have been made to control seepage at the escarpment with transverse trenches and by cutting off water at the valley head. Surface stabilization, land reshaping, and earth dams are discussed also. A geologic sketch map is included.—E.S.L.

Marvin, Richard F. *See* Muehlberger, William R. 9736

9613 **Matsumoto, Tatsuro.** Notes on *Ammonites flaccidicosta* Römer from the Cretaceous of Texas [with Japanese abs.]: Palaeont. Soc. Japan Trans. and Proc., n. ser., no. 63, p. 294–302, illus., 1966.

The above ammonite cephalopod species was described originally by F. A. Römer in 1852 on the basis of two specimens, syntypes, collected from the Upper Cretaceous Austin Group at the falls of the Guadalupe River below New Braunfels, Tex. The syntypes are here redescribed: the larger specimen is referred to *Nowakites* Spath, 1922, and designated the lectotype for *N. flaccidicostus*; the smaller is referred to

Pseudojacobites Spath, 1922, and is designated holotype of a new species, *P. texanus*. The species are compared with related species from Europe and elsewhere. Though reported from the same locality, the two species have different rock matrixes and may be from the Coniacian and lower Campanian parts of the Austin, respectively. Further collecting from better defined beds is needed for more precise evaluation.—V.M.J.

Matter, Philip, 3d. *See* Doberenz, Alexander R. 9806

9872 **Mattson, Peter H.** Unconformity between Cretaceous and Eocene rocks in central Puerto Rico, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 49–53, illus., 1966.

In the Jayuya quadrangle Eocene rocks lie unconformably upon the Cretaceous Utuado plutonic complex. The unconformity is marked by a discontinuous conglomerate unit as much as 130 m thick, with a red silty or sandy matrix, in places calcareous. Fragments in the conglomerate are angular and composed of the rocks immediately below the unconformity. The Tertiary sequence is less intricately deformed, although low-angle thrust faults or gravity slides have been mapped within it to the southeast. Thus, the part of the Utuado complex in this quadrangle was intruded in late Cretaceous or early Eocene time. The unconformity is probably of epochal significance within a still continuing revolution. The younger sequence must have been deposited when the shoreline was close to the present line of exposure of the conglomerates, bordering a tectonic island to the north; there is no evidence of later submergence.—E.S.L.

9843 **McBride, Earle F.** Sedimentary petrology and history of the Haymond Formation (Pennsylvanian), Marathon basin, Texas: Texas Univ. Bur. Econ. Geology Rept. Inv. 57, 101 p., illus., tables, 1966.

The Haymond Formation, part of a 12,000 ft sequence of flysch deposited in the Ouachita geosyncline in late Paleozoic time, is composed mainly of a monotonous sequence of intercalated fine-grained olive- to dark-brown sandstone and gray shales beds. The stratigraphy and petrology are described in detail, and interpretations on environments and modes of deposition, provenance, paleocurrent patterns of sediment transport, and sedimentological history are presented. Several stratigraphic sections which show the details of the sandstone and shale flysch facies are included.—B.S.H.

0072 **McCarty, R. B.** Albert Ernest Hartwig, Jr. (1922–1966): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 143, portrait, 1967.

McCaslin, W. E. *See* Philbin, P. W. 0105

McCloskey, L. *See* Menzies, R. J. 9906

9760 **McDougall, Ian.** Precision methods of potassium-argon isotopic age determination on young rocks, *in* Methods and techniques in geophysics, V. 2: London and New York, Interscience Publishers, p. 279–304, illus., tables, 1966.

Current techniques of K–Ar dating are described with special emphasis on dating of young rocks within the range of overlap with C-14 dating. Decay scheme and constants, basic assumptions in K–Ar dating, analytical procedures, materials useful for dating, reliability and younger limit of the method, and examples of dating of younger rocks are examined. The method has been used with excellent results in dating rocks which have been studied paleomagnetically for determining ages of magnetic field reversals. Also the precision and accuracy of dates obtained by this method have made it possible to express the relative geological time-scale in terms of millions of years, and to elucidate regional time-scales of geological phenomena in a particular region, such as the Hawaiian Islands. A reference list of 70 entries is included.—V.S.N.

9702 **McIlwaine, W. H.** Nicol township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 374, scale 1 in. to 1/4 mi., text, 1966.

From oldest to youngest, rocks in Nicol township are metavolcanics, iron formation, mafic and silicic intrusives, Cobalt Group sedimentary rocks, and Nipissing Diabase. It is difficult to determine the structure of the metavolcanics other than that they have been highly sheared and folded; except for faulting the Cobalt Group and later rocks are relatively undisturbed. The most important mineralization is native silver with lesser quantities of argentite and ruby silver; most veins are in the Nipissing Diabase. Associated with the silver are cobalt and nickel arsenides; other minerals noted are pyrite, chalcopyrite, bornite, and magnetite. Geochemical prospecting by the Geological Survey of Canada has been started in the Cobalt area.—M.C.M.

9737 **McIntyre, G. A.; Brooks, C.; Compston, W.; Turek, A.** The statistical assessment of Rb–Sr isochrons: Jour. Geophys. Research, v. 71, no. 22, p. 5459–5468, tables, 1966.

As the variance in isotope-dilution measurements of Rb-87/Sr-86 in geological samples is proportional in general to $(Rb\text{-}87/Sr\text{-}86)^2$, simple regression methods for estimating Rb–Sr isochrons are not formally valid. A new regression method which allows for known experimental error in both Sr-87/Sr-86 and Rb-87/Sr-86 and which weights the data to allow for the nonuniform Rb-87/Sr-86 variance is given, and illustrated for the Heemskirk granite of Tasmania. Analysis of the data shows that the simple method tends to underestimate the uncertainty in the age and to overestimate that in the initial Sr-87/Sr-86. Several models are considered.—D.B.V.

9599 **Meade, Robert H.** Factors influencing the early stages of the compaction of clays and sands—Review: Jour. Sed. Petrology, v. 36, no. 4, p. 1085–1101, illus., 1966.

A review with 79 references.—H.A.T.

9721 **Mehl, Maurice G.** Notes on Missouri Pleistocene peccaries: Missouri Speleology, v. 8, no. 2, p. 54–74, illus., 1966.

The distinguishing features of peccaries, the relationships of the family, and a comparison with the true pigs are presented. The geographic distribution and the habits of *Platygonus*, the only Missouri Pleistocene peccary recognized, are discussed. Evidence suggests that the peccaries were not cave dwellers (as "cave" is ordinarly defined), although nearly all of Missouri's peccary record has come from caves. Rather, it appears that these animals were common prey to cave dwelling predators. Like their present day representatives, the Pleistocene peccaries seem to have been gregarious. It is evident that many of them were root grubbers. More highly specialized than the extant genus *Tayassu*, the extinction of the platygonids may have resulted from over specialization of the feet and perhaps the teeth.—Author's abstract

Melville, R. V. *See* Durham, J. Wyatt. 9894

9906 **Menzies, R. J.; Pilkey, O. H.; Blackwelder, B. W.; Dexter, D.; Huling, P.; McCloskey, L.** A submerged reef off North Carolina: Internat. Rev. Gesamten Hydrobiologie, v. 51, no. 3, p. 393–431, illus., tables, 1966.

The salient and obvious features of topography, hydrography, geology, biology, and submarine photography of an 80–100 m deep reef-like structure located about 70 km off the North Carolina coast are described. The data suggest that the reef is located in the warm water of the Florida Current and contains a temperate-tropical fauna comparable to similar reefs previously described from the Gulf of Mexico. The main reef-former appears to be *Lithothamnion* algae associated with calcareous epifauna with an age of 19,000 yrs B.P. The living fauna arranges itself according to zones of differing sediment and appears to be a recent indigenous fauna rather than relict. The structure is worthy of considerable added future study.—*from* Authors' abstract

9612 **Meyboom, Peter; vanEverdingen, R. O.; Freeze, R. A.** Patterns of groundwater flow in seven discharge areas in Saskatchewan and Manitoba: Canada Geol. Survey Bull. 147, 57 p., illus., tables, 1966.

Theories that describe the extent of the zone of groundwater discharge require testing in the field by piezometers. Four types of piezometers were installed in selected areas on the Prairies. The areas selected are drained or bisected by deeply incised rivers or valleys, whose flanks are five to fifteen times steeper than the regional slope between the water divide and the edge of the valley. Measurements show that groundwater discharge is limited to the valley bottom. The boundary between downward flow and upward or lateral flow may lie between one fifth and one third of the way up on the valley flank. The flow resultant in a vertical cross-section through an area of downward flow may be a good approximation of the total-flow vector but the discrepancy between the total-flow vector and the flow resultant increases toward the centre of the discharge area.—*from* Authors' abstract

9867 **Meyerhoff, A. A.** Bartlett fault system—Age and offset, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 1–9, illus., 1966.

The Bartlett fault system probably is inherited from a zone of structural weakness within a former Paleozoic orthogeosyncline which extended at least from northern Central America to Jamaica. Significant fault activity along the system apparently did not begin before the middle Cretaceous orogeny. The present form of the Bartlett Trough was acquired in Miocene or Pliocene time. The linear nature of this fault system indicates that wrench movement has occurred, but vertical movements have been important also. The sinistral Bartlett fault system does not extend east of the Windward Passage. The major N. 75° W. fault system of Hispanola and Jamaica apparently is dextral. Offsets of Portlandian–early Turonian lithofacies across the Bartlett fault system do not exceed 200 km, and probably are less than 50 km.—Author's conclusions

9700 **Meyn, H. D.** (compiler). Capreol sheet, Districts of Sudbury and Nipissing: Ontario Dept. Mines Prelim. Geol. Map P. 367, scale 1 in. to 2 mi., 1966.

9628 **Miller, Halsey W.** Cretaceous vertebrate fauna from Phoebus Landing, North Carolina [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 82, no. 2, p. 93, 1966.

9891 **Miller, W. Frank.** Volume changes in bulk density samples: Soil Sci., v. 102, no. 5, p. 300–304, illus., tables, 1966.

When moist bulk-density samples were ovendried, decreases in volume of the soil core of as much as 30 percent were measured. The relationship between volume change and variation in bulk density and the independent variables of percent soil moisture by weight at sampling, percent clay, percent sand, percent organic matter, initial bulk density, and horizon designation were examined. The soil moisture content at sampling was found to be positively correlated with volume change and negatively correlated with variation in bulk density, and was in general the most significant single variable. Although volume changes were negligible in the A horizons, the B_2 horizons averaged 11 percent volume change, the B_3 horizons 13 percent, and C horizons 17 percent.—J.W.H.

9526 **Milliman, John D.** Caribbean and Indo-Pacific coral reefs [abs.], *in* Abstracts of papers related with biology—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 5: Tokyo, Sci. Council Japan [Sec. 12], p. 25, 1966.

9713 **Milling, Marcus E.; Behrens, E. William.** Sedimentary structures of beach and dune deposits—Mustang Island, Texas: Inst. Marine Sci. Pubs., v. 11, p. 135–148, illus., 1966.

Sedimentary structures of beach and dune deposits on this barrier island were studied in trenches. The following zones are characterized by distinctive stratification: the foreshore—smooth, even low angle, planar cross-strata dipping gently seaward; the backshore—irregular strata, burrows, and locally steeply dipping trough cross-strata; the wind-shadow dunes—long, smooth, even, convexo-concave cross-strata; and the foredune ridge—large scale, smooth, even, trough cross-strata. Beach and dune environments are dominated by physical forces, so primary stratification predominates over biologically and chemically produced secondary structures. The vertical succession of sedimentary structures as shown in trenches across beach and

foredune ridge suggest an offlap sequence due to prograding of the shoreline, but it might also be the result of normal sequential development of a beach following a high storm or hurricane tide.—*from* Authors' abstract

Mirayes, M. *See* Bogdanov, Yu. V. 9586

Misík, Milan. *See* Králík, Jirí. 9638

9594 **Mitchell, Edward.** The Miocene pinniped *Allodesmus*: California Univ. Pubs. Geol. Sci., v. 61, 46 p., illus., 1966.

Allodesmus was a specialized sea lion which apparently became extinct in late Miocene time. Its remains are most common in middle Miocene nearshore marine deposits of California. *Allodesmus* was not ancestral to living sea lions but appears to be most closely related to the fossil sea lion *Desmatophoca* from the middle Miocene of Oregon. *Allodesmus*, *Desmatophoca*, and the walrus-like sea lion *Dusignathus* from the Pliocene of California are placed in the subfamily of extinct sea lions called Desmatophocinae. The specializations of *Allodesmus* approach those of the living elephant seal *Mirounga* and it appears to have been well adapted to deep water swimming with specialization of sight and underwater hearing.—C.A.R.

Mitchell, R. S. *See* Geitgey, R. P. 9534

9769 **Mitchell, Richard S.** Virginia metamict minerals—Allanite: Southeastern Geology, v. 7, no. 4, p. 183–195, tables, 1966.

An X-ray diffraction study was made of heat-treated metamict allanite. Indexed X-ray powder data are given for allanite which has a structure like epidote and $a = 8.91$ A, $b = 5.72$ A, $c = 10.13$ A, $\beta = 115°$. At temperatures above about 750°C other phases begin to develop from the decomposition of the mineral. These include ceric oxide, magnetite, anorthite, and an apatite-like silicate with $a = 9.56$ A and $c = 7.04$ A. Indexed X-ray powder data for this silicate are given. Over twenty-five localities for Virginia allanite are considered, and in every case where specimens could be obtained the mineral was verified by X-ray analysis.—Author's abstract

9664 **Moench, Robert H.** Relation of S_2 schistosity to metamorphosed clastic dikes, Rangely-Phillips area, Maine: Geol. Soc. America Bull., v. 77, no. 12, p. 1449–1461, illus., 1966.

S_2 schistosity in the lower Paleozoic clastic sedimentary rocks in the Rangely-Phillips area is typically nearly parallel to axial surfaces of major northeast-trending folds. The S_2 schistosity probably developed during compression, folding, compaction, and dewatering of rapidly subsiding, impermeable pelitic sediments. Thinly tabular metasandstone and metashale dikes, which formed while the sediments were still mobile, are approximately parallel to the S_2 schistosity. The metasandstone dikes characteristically extend downward from graded beds of metasandstone. Some are paired with metashale dikes that extend upward from metashale beds. The schistosity and dikes are compared with those described by J. C. Maxwell (1962) in the Delaware Water Gap area of Pennsylvania and New Jersey.—D.H.W.

9646 **Monroe, Watson H.** Dominio litológico en la formación de algunas formas de relieve en Puerto Rico, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 2: México, D. F., Soc. Mexicana Geografía y Estadística, p. 286–291, 1966.

Landforms that develop on granitic rocks, limestone as a ridge maker, and landforms related to faults are discussed. Granitic rocks weather easily and are eroded to lowlands characterized by fine-grained topography, while limestone has an indurated shell protecting the soft interior so that it is consistently a ridge maker. Most faults have a distinctive linear depression along the trace, and some have developed prominent scarps. Weathering factors producing differential erosion are discussed. It is concluded that differences in topographic expression are closely related to differences in rocks.—E.S.L.

9874 **Monroe, Watson H.** Stratigraphic relations and sedimentation of the Oligocene and Miocene formations of northern Puerto Rico, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 54–59, illus., 1966.

Upper Oligocene and lower to middle Miocene rocks crop out in a belt about 78 mi long and up to 14 mi wide, and are divided into six formations, some of which have been subdivided into several members. The sediments were deposited apparently continuously, except for a local disconformity in the Cibao Formation and a probable disconformity between the Aymamón and Camuy Formations. The character and distribution of clastic sediments in a predominantly calcareous sequence suggest that arching of the central core along an east–west axis occurred twice during late Oligocene time. Strong arching along the axis began in the middle Miocene and culminated in an over-all uplift before the late Miocene.—*from* Author's abstract

0093 **Montgomery, Gill.** Industrial minerals in 1966: Mining Eng., v. 19, no. 2, p. 105–117, illus., 1967.

This review article contains discussions of the various commodities written by both government and industry specialists in their field.—F.C.C.

9817 **Moore, B. J.; Shrewsbury, R. D.** Analyses of natural gases of the United States, 1965: U.S. Bur. Mines Inf. Circ. 8316, 181 p., tables, 1966.

Analyses for helium and other components are reported for 528 samples of natural gas collected in 1965 as part of a continuing survey of helium resources. Samples from gas and oil wells in 21 states total 521; seven samples are from pipelines in five states.—E.R.L.

9635 **Moore, J. C. G.** Geology of the Holmes–Burt area, Districtff Timiskaming: Ontario Dept. Mines Geol. Rept. 44, 20 p., illus., tables, geol. map, 1966.

This map area, about 15 miles west of Kirkland Lake in the District of Timiskaming, is underlain by Precambrian rocks that include Keewatin-type volcanic rocks, sedimentary rocks of pre-Huronian age, plutonic felsic rocks of pre-Huronian, probably Algoman age, and diabase dikes of post-Algoman and pre-Huronian age. Amphibolites and gneisses probably represent the effect of intrusive rocks. Faulted syenite porphyry, with a composition similar to that of the Kirkland Lake area, as well as evidence of gold, copper, lead, and molybdenum mineralization, are the main features of possible economic interest.—*from* Author's abstract

0108 **Moore, John E.; Wood, Leonard A.** Data requirements and preliminary results of an analog-model evaluation—Arkansas River valley in eastern Colorado: Ground Water, v. 5, no. 1, p. 20–23, illus., 1967.

An analog model is being used to evaluate the relation of ground water to surface water and to predict effects of changes in water management. The model, simulating a 150-mile reach of the Arkansas Valley has a resistor spacing of 8 per modeled mile. The framework for the model was a transmissibility map; transmissibility ranges from less than 50,000 to 700,000 gpd per ft. Specific yield averages about 0.2. Hydrologic boundaries, such as the Arkansas River, and the bedrock-valley fill contact were simulated. Applied water, precipitation, evapotranspiration, and ground-water pumping were the independent variables programmed. The model is being verified by comparing changes in water level and river discharge with observed changes.—*from* Authors' abstract

9706 **Moore, R. K.; Dellwig, L. F.** Terrain discrimination by radar image polarization comparison: IEEE Proc., v. 54, no. 9, p. 1213–1214, illus., 1966.

Correlation of like- and cross-polarized side-looking radar images with geology in the Pisgah Crater area of the Mojave Desert clearly demonstrates the potential of a combination of such images for differentiating geologic features. The test area, 40 miles southeast of Barstow, Calif., is dominated by Tertiary and Quaternary lava flows and Quaternary alluvium and by the Pisgah Fault, along which movement

contemporaneous with outpouring of the Pisgah Flow has been recorded. The path of gravels from the mountains to a fan on the west edge of Lavic Lake may be traced on the cross-polarized image; on this the Sunshine lava flow shows black, but on the like-polarized image both the flow and the alluvium show white. The less weathered Pisgah Flow shows the same intensity on both images.—G.D.C.

Moore, Raymond C. *See* Fell, H. Barraclough. 9908

9909 **Moore, Raymond C.; Fell, H. Barraclough.** Homology of echinozoan rays, *in* Treatise on invertebrate paleontology—Pt. U, Echinodermata 3, V. 1: New York, Geol. Soc. America (and Univ. Kansas Press), p. U119–U131, illus., 1966.

Two systems for designating homologous skeletal parts of Echinozoa are based on the plane of bilateral symmetry, recognizable in all, oriented normal to the substrate. The part of the plane bisecting the interray that commonly contains the anus is considered posterior; the part bisecting the opposite ambulacral ray is anterior. In the Lovén system, adopted in the Treatise for Echinoidea (ibid., p. U221), rays are designated by Roman numerals, interrays by Arabic, progressing clockwise on the oral surface; the anterior ray is III, the posterior interray 5. In the Carpenter system, originally used for crinoids, the anterior ray is designated as A, the posterior interray as CD (clockwise on oral surface). Application of Carpenter letters to each echinozoan class and to asterozoans is discussed. The madreporite is shown to be unimportant as an orientation marker.—V.M.J.

9666 **Moorhouse, W. W.** Memorial to Elwood S. Moore (1878–1966): Geol. Soc. America Bull., v. 77, no. 12, p. P225–P231, portrait, 1966.

Morrison, B. C. *See* Lacy, R. J. 9727

9899 **Mott, R. J.** Quaternary palynological sampling techniques of the Geological Survey of Canada: Canada Geol. Survey Paper 66-41, 24 p., illus., 1966.

Methods used in sampling bogs include sampling devices, techniques of coring, and handling of samples. The Hiller peat borer is still the best device for fibrous bog deposits. A movable piston device has been developed for lowermost organic materials above inorganic sediments for radiocarbon dating. The Davis sampler is useful for very compact sediments. Lake bottom sampling utilizes more and varied equipment and different problems are encountered; a raft, casing, and special techniques are discussed. Lake deposits can be sampled for reconnaissance purposes using a gravity corer which is not suitable for palynological purposes. The Brown sampler, developed to sample across the mud-water interface, and the Livingstone sampler for sediments beneath, are invaluable tools for this purpose. Augers for surficial deposits and coring devices used in sampling permafrost are discussed briefly.—*from* Author's abstract

9736 **Muehlberger, William R.; Hedge, Carl E.; Denison, Rodger E.; Marvin, Richard F.** Geochronology of the midcontinent region, United States—[Pt.] 3, Southern area: Jour. Geophys. Research, v. 71, no. 22, p. 5409–5426, illus., tables, 1966.

Remnants of the vast 1,600- to 1,800-m.y.-old terrane of northern United States and Canada occur in Colorado, northern New Mexico, and northeastern Kansas. The Precambrian basement rocks of the area record essentially continuous igneous activity during late Precambrian time: 1,450–1,600 m.y., 1,100–1,350 m.y., 1,200–1,350 m.y. (St. Francois activity), 1,150–1,300 m.y. (Spavina activity), and 1,100–1,200 m.y. (Panhandle activity). The cycle of sedimentation, deformation, metamorphism, and intrusion that occurred 1,100–1,150 m.y. ago in central Texas is named the Llano orogeny. The Wichita Mountains igneous activity occurred in Cambrian time, 500 m.y. ago.—D.B.V.

Muehlberger, William R. *See* Goldich, Samuel S. 9765

Murray, J. W. *See* Tiffin, D. L. 9776

0097 **Nackowski, M. P.** Geological engineering in 1966: Mining Eng., v. 19, no. 2, p. 75–77, 1967.

Geological engineering expanded its role and significance in the areas of construction, raw materials exploration and inventory, water supply and pollution, mechanical properties of earth materials and regional environmental planning. Efforts varied immensely in scope and magnitude.—F.C.C.

Nagata, T. *See* Kono, M. 9825

9798 **Nagy, Bartholomew.** Investigations of the Orgueil carbonaceous meteorite: Geol. Fören. Stockholm Förh., v. 88, no. 2, p. 235–272, illus., tables, 1966.

The composition and texture of the Orgueil carbonaceous chondrite are described. The bulk chemical composition is similar to that of the unfractionated primeval gas cloud. The origin of the organic matter and organized elements, and the petrogenesis are not yet known with sufficient certainty; but it is generally accepted that part of the complex organic matter is indigenous to the meteorite. Urey (1962,1965) has suggested that this meteorite might be a lunar rock fragment representing primeval lunar inorganic matrix which became contaminated with terrestrial organic matter during the violent processes that must have accompanied the capture of the Moon by (or its escape from) the Earth.—D.B.V.

9658 **Nagy, Dezső.** The prism method for terrain corrections using digital computers: Pure and Appl. Geophysics, v. 63, p. 31–39, illus., table, 1966.

A prism method for terrain correction of gravity data is presented, which has no computational limitations. It can be used on all sizes of computers, can be applied to a large area with any fine grid interval, can be processed in a single run, and yet provides complete flexibility for both research and routine computations. The basic elements are prisms which form a model of the terrain. The more closely the model approximates the topography, the more closely the calculated correction approximates its true value. The method is used to calculate terrain corrections for 130 stations in the New Quebec crater area. Corrections calculated using Hammer's template for five of these stations differ by less than four percent. D.B.V.

9650 **Nakayama, F. S.** Deflocculation of soil materials by sodium salts: Soil Sci., v. 102, no. 6, p. 388–393, illus., 1966.

The dispersive behavior of three soils was studied when treated with different rates of NaCl, Na_2SO_4, Na_2CO_3, and $(NaPO_3)_6$. Dispersion of the soils was in the order $(NaPO_3)_6 \geq Na_2CO_3 > Na_2SO_4 = NaCl$. Where the Ca status of the soil is high Na_2CO_3 may be as effective a dispersing agent as $(NaPO_3)_6$. The NaCl and Na_2SO_4 treatment resulted in flocculation of the particles with increasing treatment rates, possibly caused by an increase in the electrolyte concentration. The Na_2CO_3 and $(NaPO_3)_6$ treatment increased deflocculation with increasing treatment rates.—J.W.H.

9871 **Nelson, Arthur E.** Some volcanic rocks of the Corozal quadrangle, Puerto Rico, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 41–48, illus., tables, 1966.

Andesite, basalt, and basaltic tuff are exposed with associated sedimentary rocks in the south half and east-central part of the Corozal quadrangle in north-central Puerto Rico. The basalt is amygdaloidal and pillowed, has phenocrysts of augite, and occurs as lenticular flows, locally grading into flow breccia. Pillow structures in the andesite are more irregular and larger than in the basalt, and the flows are characterized by clusters of plagioclase phenocrysts. Basaltic tuffs, containing green augite crystals, are interbedded with the basalt. The oldest basalt flows are older than either the andesite or the basaltic tuff, and most of the basalts are older than the andesites. The tuffs have the greatest stratigraphic range. Field relationships and chemical and mineralogical studies show that the volcanic rocks are closely related.—*from* Author's abstract

Nettleton, W. D. *See* Daniels, R. B. 9606

Newmont Exploration Staff. *See* Brant, Arthur A. 9723

9589 **Niedoroda, Alan.** Preliminary study of transverse bars on low energy beaches: Coastal Research Notes, v. 2, no. 3, p. 3–4, 1966.

A low energy beach with several transverse bars, on the east shore of St. James Island, Franklin County, northwest Florida, was studied during the summer of 1966 in an attempt to understand the origin of these bars. When the tide was less than about 40 cm above the transverse bars, waves approaching the beach were refracted above the bars, and a current moving toward the beach developed beneath the interfering waves. This in conjunction with the normal current parallel to the beach made the movement of water quite complex during the period when the tide was at this low level. Model studies in a wave tank also were carried out. Further research is planned.—E.S.L.

9485 **Noble, Calvin A.** Swelling measurements and prediction of heave for a lacustrine clay [with French abs.]: Canadian Geotech. Jour., v. 3, no. 1, p. 32–41, illus., 1966.

The swelling characteristics of a post-glacial lacustrine clay [Regina area, Saskatchewan] were studied by means of standard consolidation apparatus. The amount of swelling was measured for undisturbed specimens and remoulded specimens prepared to constant initial conditions. Specimens were allowed to swell under various surcharge loads. An empirical relationship was obtained between volume change, surcharge load, and initial water content. Swelling pressure for no volume change was obtained by three experimental procedures for different initial water contents and compared to values calculated from physico-chemical equations. Undisturbed specimens showed less swelling than remoulded specimens, but otherwise the results showed similar trends.—Author's abstract

9482 **Noe-Nygaard, Arne.** Chemical composition of tholeiitic basalts from the Wyville-Thompson Ridge belt: Nature, v. 212, no. 5059, p. 272–273, table, 1966.

The Thulean basalts of Greenland have been thought to belong to a single petrographic province, but as such have been difficult to group. New data on the Faroes suggest that in Iceland two volcanic belts cross each other; one is the still active Mid-Atlantic Ridge zone, and the other the older Wyville-Thompson Ridge and its westward continuation, on which the early Faroes and early Iceland originated and which also gave rise to basaltic volcanism in Greenland and northwest Scotland. Differences in composition between the two belts could be the result of original regional differences in the oceanic crust and upper mantle, or of a difference in trend or stage of development of two intraoceanic belts which were not mobile at the same time.—D.B.V.

9770 **Nowlan, J. P.** Presidential address—Geologists in our present economy: Geol. Assoc. Canada Proc., v. 17, p. 13–19, 1966.

Geologists, regarded ten decades ago as little better than freaks with work limited to regional mapping, have become essential in many fields and important luxuries in a number of others. Curricula and fields of interest, both applied and research, have broadened to attract talented men and women. Federal and Provincial governments are major employers of a great variety of specialists. A large range of choices also exists in the mining and petroleum industries, engineering fields, ground-water management, submarine and space exploration, medical field, and teaching field. Experiences in reaching high school students, and general public relations are discussed.—G.D.C.

Nowroozi, A. A. *See* Alsop, L. E. 9922

9804 **Nuckolls, M. J.; Fuller, R. K.** Sieve analysis of particles smaller than 44 microns in diameter: Soil Sci., v. 102, no. 5, p. 292–295, illus., 1966.

A method of particle-size analysis, utilizing ultrasonic energy and micro mesh sieves, has been developed for dust particles with diameters less than 44 microns. The new method yields discrete particle-size fractions, rather than fractions that contain

all particle sizes less than a stated size, as produced by liquid sedimentation methods.—J.W.H.

0052 **Nunnally, Nelson R.** Definition and identification of channel and overbank deposits and their respective roles in flood plain formation: Prof. Geographer, v. 19, no. 1, p. 1–4, illus., 1967.

Although point-bar formation as a process of flood plain formation has been attributed to channel deposition, or lateral accretion, it is suggested that this is inaccurate and results from the lack of rigid definitions as to what constitutes channel as opposed to overbank deposition. Studies along the lower Ohio River indicate that overbank deposition occurs when any part of the flood plain is inundated. Where banks are sloping the boundary between the flood plain and channel is defined as the channelward limit of perennial trees. Channel deposits are those on the channelward side of this boundary; overbank deposits are those on the flood plain side. Where deposits are continuous it may be possible to separate overbank from channel deposits on the basis of texture, the channel deposits being the coarser.—L.L.R.

Nuttli, Otto W. *See* Bolt, Bruce A. 9930

9555 **Oberg, Rolland.** The conodont fauna of the Viola Formation [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1515B, 1966.

0089 **Oklahoma Geology Notes.** Louise Jordan, 1908–1966: Oklahoma Geology Notes, v. 27, no. 1, p. 3–8, portrait, 1967.

9633 **Olson, Richard H.** A survey of industrial mineral possibilities in Nevada, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. B: Nevada Bur. Mines Rept. 13, pt. B, p. 25–38, illus., 1966.

Nevada, with a population too small to support some types of industrial mineral operations, does lie near rapidly growing Pacific Coast markets, particularly California. This report is concerned with the gypsum, diatomite, limestone, magnesite, clay, and brine deposits. No area of comparable size in the western United States has so many large exposed gypsum deposits as does southern Nevada; these span Permian to Quaternary time. Smaller deposits in northwestern Nevada are of probable Triassic–Jurassic age. Practically all of the world's known diatomite deposits are in California and Nevada, the first of marine origin, the other of fresh-water origin and not so thick but of good filter grade. The kaolin deposits are hydrothermally altered tuffaceous strata, with free and other disseminated non-clay material.—G.D.C.

9504 **O'Neil, James R.; Epstein, Samuel.** A method for oxygen isotope analysis of milligram quantities of water and some of its applications: Jour. Geophys. Research, v. 71, no. 20, p. 4955–4961, illus., tables, 1966.

A rapid and precise technique is described for analyzing milligram amounts of water for oxygen isotopic content by reaction with BrF_5. Because there is no measurable memory effect, the method is more reliable than others when only enough material for one analysis is available. A value of 1.0407 ± 0.0004 was determined for the CO_2–H_2O fractionation factor at 25°C, a value necessary for relating standards used by various workers. The technique is applied to study of a meteorological problem.—D.B.V.

0066 **Page, Benjamin M.; Tabor, Lawrence L.** Chaotic structure and décollement in Cenozoic rocks near Stanford University, California: Geol. Soc. America Bull., v. 78, no. 1, p. 1–12, illus., geol. map, 1967.

Chaotic structure and possible décollement relations, previously little known in Cenozoic rocks of the Coast Ranges, have recently been exposed 25 miles southeast of San Francisco, Calif. Orderly Eocene sandstone-mudstone sequences are interrupted by chaotic zones consisting of disordered mudstone with scattered and rotated bodies of sandstone. It is believed that the chaotic structure resulted in part from Eocene submarine sliding. After the Eocene rocks were moderately folded,

Miocene strata were deposited unconformably upon them. Pliocene–Pleistocene thrusting and folding moved the Miocene strata northeastward relative to the underlying Eocene rocks, apparently producing a surface of décollement. Continued folding involved the décollement surface itself, increased the structural complexity of the chaotic zones, and locally overturned intact strata.—Authors' abstract

Papke, Keith G. *See* Wines, S. Vernon. 9642

9580 **Park, Charles F., Jr.** Exploration philosophy, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. A: Nevada Bur. Mines Rept. 13, pt. A, p. 39–43, 1966.

The field of the professional prospector is no longer a simple one of observation; the field geologist is lost in modern exploration without the support of a strong laboratory science group. Techniques of exploration are changing and tools are becoming more formidable. Present day prospecting is comparatively expensive, therefore it becomes almost prohibitive for many individuals and small groups.—M.C.M.

9626 **Parker, John M., 3d.** Triassic reptilian fossil from Wake County, North Carolina [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 82, no. 2, p. 92, 1966.

9556 **Pashley, Emil Frederick, Jr.** Structure and stratigraphy of the central, northern, and eastern parts of the Tucson basin, Arizona [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1516B, 1966.

Patchick, Paul F. *See* Wozab, David H. 9880

9511 **Paterson, Norman R.** Mattagami Lakes Mines—A discovery by geophysics, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 185–196, illus., 1966.

The Mattagami Lake Mines orebody, Watson Lake, Quebec, was discovered by airborne electromagnetometer surveying. Ground electromagnetic, magnetic, and gravity surveys helped to pinpoint the orebody for diamond drilling. A total expenditure of 500,000 dollars for exploration discovered a mine valued at more than 700 million dollars.—E.S.L.

9796 **Pavoni, N.** Tectonic interpretation of the magnetic anomalies southwest of Vancouver Island: Pure and Appl. Geophysics, v. 63, p. 172–178, illus., table, 1966.

A tectonic interpretation of the magnetic anomalies off the coast of California, Oregon, and Washington between 40° and 52° north latitude shows that in the area surveyed the oceanic crust is cut by seven major dislocation zones which divide the region into eight areas. For five of these areas the original connection can be reconstructed. The existence of a "window" of young crust surrounded by older crust and of a short, isolated length of active oceanic ridge southwest of Vancouver Island as proposed recently by different authors is not confirmed.—Author's summary

Pawson, D. L. *See* Durham, J. Wyatt. 9894

Pawson, David L. *See* Frizzell, Don L. 9913

9882 **Pease, Maurice H., Jr.** Some characteristics of copper mineralization in Puerto Rico, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 107–112, illus., 1966.

Most copper deposits in Puerto Rico occur in elongate bodies of altered "orthoclase"-quartz diorite porphyry along or within major west-northwest-trending shear zones and commonly adjoining or closely associated with larger granitic-textured plutons. Deuteric and/or hydrothermal processes almost invariably have partly altered the porphyry. Copper minerals are diffused throughout the porphyry and essentially confined to it. Concentrations occur in bands of highly fractured rock. Less commonly, copper mineralization occurs in

veins within volcanic rock either adjacent to intrusive rock or associated with a major shear zone. Limestone is also commonly a host. Chalcopyrite is the principal ore mineral, with lesser amounts of molybdenite; gold and silver are present in most deposits. Puerto Rico appears to be part of a relatively unexploited copper province that extends throughout the Greater Antilles.—*from* Author's summary

9884 **Perelli, Richard J.** Geology and ore occurrences at Mavis Bank, Parish of St. Andrew, Jamaica, W. I., *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 122, 1966.

Control for mineralization at Mavis Bank, Jamaica, is the thrust fault contact of the Newcastle Porphyry and the Wagwater series. Copper occurs as dissemination in the porphyry, as replacements of limestone, and as pyrometasomatic deposits, with chalcopyrite as the principal copper mineral. Magnetite occurs as a limestone replacement in steeply dipping vein-type deposits and as xenoliths in the porphyry.—E.S.L.

9886 **Pessagno, Emile A., Jr.** Upper Cretaceous radiolaria from Puerto Rico, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 160–166, illus., 1966.

A rich radiolarian assemblage has been recovered from strata of the early Campanian *Dictyomitra multicostata* zonule of southern Puerto Rico. Twelve species of radiolaria, eight of which are new, have been noted. The Puerto Rican radiolarian assemblage is significant because it contains species in common with strata of the same age in Mexico and England, and because it occurs with a rich neritic assemblage of foraminifera. Radiolaria should make excellent index fossils as they are planktonic, often abundant, and show great variety of form, but the value is limited because they have been so poorly studied. A correlation chart of Upper Cretaceous rocks, charts showing zonation of Santonian to Maestrichtian strata in southern Puerto Rico, and early Campanian radiolaria are included.—E.S.L.

Petrafeso, F. A. *See* Balsley, J. R. 0102

0105 **Philbin, P. W.; McCaslin, W. E.** (compilers). Aeromagnetic map of part of the Beechwood quadrangle, Michigan and Wisconsin: U.S. Geol. Survey Geophys. Inv. Map GP-603, scale 1:62,500, 1967.

9693 **Philbin, P. W.; Smith, C. W.** Aeromagnetic map of the Rockville quadrangle, Hartford and Tolland Counties, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-587, scale 1:24,000, 1966.

9694 **Philbin, P. W.; Smith, C. W.** Aeromagnetic map of the Hampton quadrangle and part of the Scotland quadrangle, Windham County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-593, scale 1:24,000, 1966.

9695 **Philbin, P. W.; Smith, C. W.** Aeromagnetic map of the Avon quadrangle, Hartford County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-594, scale 1:24,000, 1966.

9696 **Philbin, P. W.; Smith, C. W.** Aeromagnetic map of the Hartford North quadrangle, Hartford County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-595, scale 1:24,000, 1966.

9597 **Picard, M. Dane.** Oriented, linear-shrinkage cracks in Green River Formation (Eocene), Raven Ridge Area, Uinta Basin, Utah: Jour. Sed. Petrology, v. 36, no. 4, p. 1050–1057, illus., 1966.

Oriented linear shrinkage cracks in the Green River Formation of the Uinta Basin, Utah, are subparallel features that consist of cemented coarse silt dike-like bodies a few tens of millimeters long and less than 10 mm wide that seem to be crack fillings. The features are subparallel to each other and to the crests of ripple marks with which they commonly but not exclusively occur. The features are thus at right angles to current directions.—H.A.T.

9918 **Picard, M. Dane.** Iron oxides and intensity of magnetization in Chugwater Formation (Triassic), Wyoming: Royal Astron. Soc. Geophys. Jour., v. 11, no. 5, p. 557–560, 1966.

In the sediments of the Chugwater Formation (Triassic), Wyoming, no simple relationship exists between iron contents, intensity of magnetization, and the normal or reversed nature of the magnetic field directions. Two probable reasons are: (1) iron is distributed in a large number of minerals viz. hematite (grains and grain coatings), ilmenite, magnetite, goethite, pyrite, siderite, chlorite, and possibly illite, mixed-layered clays, dolomite, and feldspar; and, (2) depending on the diagenetic history of the rocks, there may be both stable and unstable magnetization in some of the minerals.—A.B.M.

Pilkey, O. H. *See* Menzies, R. J. 9906

9829 **Pissart, A.** Le role géomorphologique du vent dans la région de Mould Bay (Île Prince Patrick—N.W.T.—Canada) [with English and German abs.]: Zeitschr. Geomorphologie, new ser., v. 10, no. 3, p. 226–236, illus., 1966.

The author records his observations made during a three months' stay on Prince Patrick Island concerning wind action in the western Canadian Arctic. The absence of wind-facetted and rarity of windpolished pebbles, like the general lack of deflation surfaces, indicate that direct action by wind is of minor importance. Nevertheless, the existence of niveo-aeolian deposits suggests that deflation occurs, to some extent on the tops of hills which are without snow cover in winter, but mainly on the valley floors of braided rivers. The deposits seldom have any obvious effect on the landscape, except where they form occasional sandy trains or where they cover tundra polygons in areas immediately bordering certain flood plains. The relative unimportance of wind action is mainly due to the absence of strong winds, and results are seen only in combination with nivation.—*from* Author's English abstract

9845 **Pitman, W. C., 3d; Heirtzler, J. R.** Magnetic anomalies over the Pacific-Antarctic Ridge: Science, v. 154, no. 3753, p. 1164–1166, 1171, illus., table, 1966.

Four magnetic profiles across the Pacific-Antarctic Ridge reveal anomalies trending parallel with and symmetrical about the ridge axis. The geometry of the bodies that could cause these anomalies accords with known geomagnetic field reversals during the last 3.4 m.y., indicating an ocean-floor spreading rate of 4.5 cm per yr. If the spreading rate within 500 km of the ridge has been constant, geomagnetic reversals during the last 10.0 m.y. can be determined. This new detailed history of field reversals accords with observed anomalies over Reykjanes Ridge in the North Atlantic, if a spreading rate of 1 cm per yr is assumed there.—D.B.V.

Pollock, James P. *See* Weege, Randall J. 9632

0080 **Porter, A. L.** Oil and gas conservation in New Mexico [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 168, 1967.

9480 **Powell, J. L.; DeLong, S. E.** Isotopic composition of strontium in volcanic rocks from Oahu: Science, v. 153, no. 3741, p. 1239–1242, illus., table, 1966.

The mean Sr-87/Sr-86 ratio in the Koolau volcanic series on Oahu (0.70385 ± 0.00009) is significantly higher than the ratio in the other two series (Waianae, 0.7030 ± 0.00010, and Honolulu, 0.7029 ± 0.00006). With one exception, there are no significant differences in Sr-87/Sr-86 within a series, despite some large compositional differences.—D.B.V.

9557 **Pratt, Howard Riley.** Progressive metamorphism of calc-silicate rocks, Connecticut [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1516B–1517B, 1966.

Pryslak, A. P. *See* Davies, J. C. 9699

9938 **Psuty, Norbert P.** Regiones geomórficas tabasqueñas, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 38–45, 1966.

The State of Tabasco nearly coincides with the last major depositional units of the Quaternary basin. Wedge-shaped deposits increase in depth toward the sea due to ample discharge of rivers into the Gulf of Mexico under extremely humid conditions; sedimentary cycles were much like those of the Mississippi basin. The record indicates the closing phases of Wisconsin glacial stages, subsequent sea-level changes, and recent deposition, with delta centers moving northward along the coast. There are three morphologic categories: the Pleistocene depositional terrace, Recent deltaic plains, and recent coastal forms, with bars, parabolic dunes, and lagoons. The present drainage also is distributary.—G.D.C.

9684 **Puchner, Herbert F.; Holland, Heinrich D.** Studies in the Providencia area, Mexico—[Pt.] 3, Neutron activation analyses of fluid inclusions from Noche Buena: Econ. Geology, v. 61, no. 8, p. 1390–1398, illus., tables, 1966.

Sodium in the inclusion fluids ranged from 0.8 to 1.8 percent, and Mn content from 50 to 70 ppm. Copper and zinc were below their detection limits of 12–24 ppm and 260–580 ppm, respectively, even though they were probably in equilibrium with chalcopyrite and sphalerite when entrapped.—W.S.W.

9558 **Pushkar, Paul Demitro.** The isotopic composition of strontium in volcanic rocks from island arcs [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1517B, 1966.

9820 **Pye, E. G.** (editor). Summary of field work, 1966, by the Geological Branch: Ontario Dept. Mines Prelim. Rept. P.R. 1966-1, 65 p., illus., tables, 1966.

There were 25 field parties at work in the province in 1966, and their locations and that of the seven resident geologists' offices are shown on a map. A brief summary of the results of the field work in six districts and one county is given in Part A; reports from the resident geologists' offices comprise Part B. A geologic sketch map of Operation Kapuskasing is included.—E.S.L.

9659 **Quebec Department of Natural Resources.** Field work in 1965—Summary of results: Quebec, Quebec Dept. Nat. Resources, 43 p., illus., 1966.

Each of 28 mapping projects are located on an accompanying map, almost all in the southern half of the Province of Quebec. Of these, 20 were areal mapping projects of the Geological Exploration Service which also carried out five miscellaneous detailed projects; seven were undertaken by the Mineral Deposits Service, and one by the Groundwater, Natural Gas and Petroleum Service—hydrogeology in the Eaton River basin and subsurface exploration in scattered municipalities. In addition there were special studies on peat, industrial minerals and building materials, and mineral-water springs. Preliminary reports and maps will be followed by colored maps and final reports; some project work is the basis for graduate theses.—G.D.C.

9735 **Quigley, R. M.; Thompson, C. D.** The fabric of anisotropically consolidated sensitive marine clay [with French abs.]: Canadian Geotech. Jour., v. 3, no. 2, p. 61–73, illus., table, 1966.

The relationship between soil fabric and the anisotropic consolidation characteristics of the sensitive, highly flocculated Leda clay from Ontario has been studied using X-ray diffraction techniques. The amplitudes of the 10A clay peaks of the "undisturbed" natural clays, measured in the major principal plane, increased from 11 counts per second at low pressures to 40 counts at 64 tons per sq ft, as a result of reorientation of the clay platelets into the plane perpendicular to the direction of the consolidation pressure. Remolding the clay causes breakdown of the interparticle bonds and greater particle parallelism at any consolidation pressure within the range studied. This increase is associated with a reduction in void ratio when compared with the "undisturbed" clay.—*from* Authors' abstract

Quirk, J. P. *See* Aylmore, L. A. G. 0049

Quirk, J. P. *See* Aylmore, L. A. G. 9811

9663 **Rader, Eugene K.** Breccia along the "Staunton–Pulaski" fault in the Staunton 15′ quadrangle [abs.], *in* Virginia Acad. Sci. Proc. 1965–66: Virginia Jour. Sci., new ser., v. 17, no. 4, p. 320–321, 1966.

9828 **Rahn, Perry H.** Inselsbergs and nickpoints in southwestern Arizona [with French and German abs.]: Zeitschr. Geomorphologie, new ser., v. 10, no. 3, p. 217–225, illus., table, 1966.

The study of 77 inselbergs in southwestern Arizona supports the hypothesis that the sharp break-in-slope, or nickpoint, between mountains or inselbergs and the adjacent desert plains, originates by passing streams cutting laterally against the mountain spurs. This break in slope is maintained after the streams migrate away, if the bedrock weathers to large-size detritus, but if it weathers to pebble-size or finer debris, this material washes down the slope and covers up the sharp break-in-slope.—E.S.L.

9853 **Raïsz, Erwin.** Representación de la morfología en mapas, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 5: México, D. F., Soc. Mexicana Geografía y Estadística, p. 11–27, illus., 1966.

The most difficult problem in cartography is that of showing landforms. The first known attempt, illustrated herein, is a clay tablet from Mesopotamia of about 2500 B.C. Other early examples are given also. In analyzing the problem, the principal elements are relative relief and inclination; most important is consideration of the source and availability of data on which the scale depends. Aerial photographs have been useful in interpretation of data and configuration, and photographs from satellites offer a new opportunity for details on a small scale. Curves and contour lines used to show differences in elevation and inclination, and types of relief are illustrated.—G.D.C.

Ramspott, L. D. *See* Crawford, Thomas J. 9790

9921 **Randall, M. J.** Seismic radiation from a sudden phase transition: Jour. Geophys. Research, v. 71, no. 22, p. 5297–5302, 1966.

The hypothesis that sudden phase transition may provide a mechanism for earthquakes is examined mathematically, the model allowing change of shape as well as of density. The basic distortional change gives a radiation pattern like that of the double-couple multipole.—Author's abstract

9657 **Rankin, Douglas W.** Quartz latite of Traveler Mountain; road log—Devonian volcanic and sedimentary rocks on the northwest flank of the Weeksboro–Lunksoos Lake anticline, *in* Guidebook . . . in Mount Katahdin region, Maine—New England Intercollegiate Geol. Conf., 58th Ann. Mtg. 1966: [Augusta, Maine Geol. Survey] p. 28–35, illus., 1966.

The quartz latite occupies a structurally depressed, roughly quadrilateral area on the northwest limb of the Weeksboro–Lunksoos Lake Anticline, bounded by high-angle faults on the north and west and intruded by the quartz monzonite of Mount Katahdin on the south. The depression is thought to be an ancient caldera; the volume of quartz latite within it is on the order of 80 cu mi. Many rocks are sufficiently recrystallized that thin sections, needed to distinguish the apparently homogeneous rock types, are of little help. The latite has been divided into a lower member characterized by ash-flow tuffs with 15 percent phenocrysts, of which about one-third are quartz, and an upper member characterized by lava with sparse quartz phenocrysts. The quartz latite of Traveler Mountain may represent an inverted magma chamber.—G.D.C.

9822 **Ransom, Jay Ellis.** The rocks and fossils of California's Rincon: Gems and Minerals, no. 351, p. 30–32, illus., 1966.

Mineral, rock, and fossil collecting possibilities on the beaches and shelving terraces of the Rincon, west of Ventura, are described. Gravel windrows on the beaches contain brecciated marble, agatized bone, jasper, and seamed quartzite. Pliocene and Pleistocene fossils can be collected from bluffs in Los Sauces Canyon.—E.S.L.

9812 **Rathjens, Carl; Kaiser, Karlheinz; Graul, Hans.** Eiszeitforschung in Nordamerika—Berichte über den VII. INQUA-Kongress 1965 in den USA und die im Zusammenhang damit durchgeführten Exkursionen: Zeitschr. Geomorphologie, new ser., v. 10, no. 3, p. 311–340, illus., 1966.

The paper reviews the meetings and excursions of the 7th INQUA congress.—E.S.L.

0082 **Reed, Ed L.** Economic evaluation of water sources for waterflooding problems [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 169, 1967.

9911 **Regnéll, Gerhard.** Edrioasteroids, *in* Treatise on invertebrate paleontology—Pt. U, Echinodermata 3, V. 1: New York, Geol. Soc. America (and Univ. Kansas Press), p. U136–U173, illus., 1966.

The class Edrioasteroidea were formerly included in the subphylum Pelmatozoa because of their dominantly sessile nature, but are here considered echinozoans because of the covered ambulacral grooves (for food collecting), absence of all exothecal appendages, and absence of a stem. The edrioasteroids range from Lower Cambrian to Upper Mississippian and are represented by 27 genera in five families. Most edrioasteroids were permanently attached to the substrate or to hard foreign objects by the aboral surface; but the Edrioasteridae were probably capable of restricted movement, as the ambulacra extend onto the marginal area of the aboral surface. There are few obvious evolutionary trends, except for extension and increased curvature of ambulacra, and a tendency toward a free-living mode in a few forms.—V.M.J.

Richards, David B. *See* Hurr, R. Theodore, 9521

9813 **Richards, Horace G.** Philadelphia's fossils—Dinosaurs in your backyard: Frontiers, v. 31, no. 2, p. 36–41, illus., 1966.

Fossil collecting grounds in the Philadelphia area are the Triassic shales and Cretaceous sands and clays of southern New Jersey. Discovery of a Cretaceous dinosaur, *Hadrosaurus minor*, at Sewell, N. J., and a Pleistocene ground sloth, *Megalonyx jeffersoni*, at Fellowship, N. J., are described. Some of the unusual fossils presented to the Academy of Natural Sciences of Philadelphia by a club for teen-age boys are listed.—E.S.L.

9934 **Richter, D. H.** Geology of the Slana district, southcentral Alaska: Alaska Div. Mines and Minerals Geol. Rept. 21, 51 p., illus., tables, geol. map, 1966.

The Slana district is underlain by a thick sequence of Permian volcanics and marine sediments which have been intruded by dioritic rocks, a zoned quartz monzonite pluton, and a variety of hypabyssal rocks ranging from gabbro to dacite. Severe deformation and doming of the layered rocks resulted from the intrusions of the dioritic complex and the quartz monzonite pluton. Quartz and quartz carbonate veins containing galena, sphalerite, chalcopyrite, and argentiferous tetrahedrite are the principal ore deposits, and occur in a well defined zone around the southern end of the pluton. Strong lead, zinc, and molybdenum anomalies are present in stream sediments of this zone. Geologic, geochemical, and economic maps accompany the report.—B.S.H.

9731 **Riddell, Paul A.** Magnetic observations at the Dayton iron deposit, Lyon County, Nevada, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 418–428, illus., 1966.

Magnetic observations were taken at surface and at several altitudes over the Dayton iron deposit in western Nevada. The magnetic information is plotted in vertical sections and presents a new means of making an empirical evaluation of optimum flight line spacing and terrain clearance for future aeromagnetic exploration

programs for magnetite ore bodies. A test is made of several rules-of-thumb that are commonly used to determine the width of the causative body and its depth below the plane of observation. Several of these methods give reasonably good comparisons with actual depths and widths.—Author's abstract

9936 **Riley, Lee R.** The challenge of deep exploration—The Chitwood pool, Grady County, Oklahoma: Shale Shaker, v. 17, no. 4, p. 66–73, illus., 1966.

The discovery well at Chitwood was completed as a gas condensate well from the Springer–Cunningham sand at 10,800 feet in 1945. A discovery was completed in 1962 as a gas condensate well at about 17,000 feet in the Bromide sands of the upper Simpson (Ordovician). The structure consists of two domes; in Ordovician through Mississippian, the east dome is higher, but is 900 feet lower on the Pennsylvanian Springer Formation due to shale squeeze. Some faults are present in the area. The Ordovician to Permian stratigraphy is reviewed, and a set of conditions given to explain the factors associated with Bromide gas condensate production. Ten thin sections of the sand are included.—E.S.L.

9528 **Robbins, Thomas; Leinhardt, T. E.** Apparatus for the study of the spectra of luminescent minerals at low temperatures [abs.], *in* Virginia Acad. Sci. Proc. 1965–66: Virginia Jour. Sci., new ser., v. 17, no. 4, p. 259, 1966.

9574 **Roberts, Ralph J.** Metallogenic provinces and mineral belts in Nevada, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. A: Nevada Bur. Mines Rept. 13, pt. A, p. 47–72, illus., table, 1966.

Nevada contains two metallogenic provinces—eastern with lead–zinc and peripheral gold–silver; western with gold, silver, mercury, and antimony. A transitional zone roughly coincides with the boundary between Paleozoic facies in the Cordilleran geosyncline—carbonate on the east and siliceous and volcanic on the west. Different suites of metals in the two provinces may reflect differences in crustal and mantle rocks. Metallogenic provinces, mineral belts, and ore deposits in Nevada are related to structural features assigned to four orders, from oldest to youngest: northeast-striking geosynclinal trends; east–west-striking orogenic trends; northwest and east–west trending mineral belts that follow deep fractures; and diverse trending fractures that control ore deposits within individual mining districts. The mineral belts are considered most favorable for concealed deposits.—*from* Author's abstract

Robinson, C. S. *See* Warner, L. A. 0070

9876 **Robinson, E.** Eocene limestones in eastern Jamaica, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 71–74, illus., 1966.

With local exceptions, the Middle and Upper Eocene limestones east of the Wagwater fault are variations of the Montpelier limestone of earlier authors. The principal varieties are an upper group of chalks and recrystallized fine grained limestones with cherts and a lower group of marly chalks interbedded with shales. The latter rocks are correlated with the Yellow Limestone formation of central Jamaica and passage beds are seen in western St. Mary, where the group as a whole overlies the Richmond formation conformably. The larger foraminiferal faunas differ from those of central Jamaica but resemble those of Cuba and Haiti. Author's abstract

9808 **Robinson, Edward.** (editor). Transactions of the third Caribbean Geological Conference held at Kingston, Jamaica, 2d–11th April 1962: Jamaica Geol. Survey Pub. 95, 187 p., illus., tables, 1966.

The Transactions include 33 papers, covering all aspects of the geology of the Caribbean region, 26 of which are cited separately.—E.S.L.

9596 **Robinson, P. T.** Zeolitic diagenesis of Mio–Pliocene rocks of the Silver Peak Range, Esmeralda County, Nevada: Jour. Sed. Petrology, v. 36, no. 4, p. 1007–1015, illus., 1966.

Vitric material in Miocene and Pliocene tuffs and tuffaceous sedimentary rocks of the Silver Peak Range of western Nevada has been extensively altered to zeolites, clay minerals, and celadonite. Widespread distribution of the altered rocks indicates a diagenetic origin. The alteration took place after burial under the influence of alkaline and saline ground-water solutions.—Author's abstract

Rodda, Peter U. *See* Fisher, W. L. 9900

9559 **Roddy, David John.** The Paleozoic crater at Flynn Creek, Tennessee [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1517B–1518B, 1966.

9501 **Roden, Gunnar I.** Low-frequency sea level oscillations along the Pacific Coast of North America: Jour. Geophys. Research, v. 71, no. 20, p. 4755–4776, illus., tables, 1966.

Statistical analysis of monthly mean sea levels along the Pacific Coast of North America leads to several conclusions, including: (1) The only significant periodicities are those pertaining to annual and, sometimes, to semiannual oscillations; both are principally of meteorological origin. (2) Secular trends are due to land uplift or subsidence rather than to long-term climatological changes; this conclusion is supported by the fact that the trends at nearby stations are frequently different.—D.B.V.

9512 **Rogers, George R.** Introduction [*to* The search for disseminated sulfides, Chap. 4], *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 265–272, illus., table, 1966.

The term disseminated sulfide has been defined as sulfide scattered as specks and veinlets through rock and constituting not over 20 percent of the total volume. The majority of the important producing porphyry copper mines are disseminated sulfide deposits containing economic quantities of copper and/or molybdenum. Physical properties of the sulfide deposits discussed are density, magnetic susceptibility, and electrical. Case histories demonstrate that the induced-polarization technique is quite efficient in detecting zones with low sulfide content, and that pyrite is a complicating factor in estimating economic value. Induced polarization and the resistivity field techniques are reviewed.—E.S.L.

9728 **Rogers, George R.** An evaluation of the induced-polarization method in the search for disseminated sulfides, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 350–356, illus., table, 1966.

Since the IP method provides diagnostic information regarding the presence of those minerals with metallic luster, it is emerging as an important technique in the search for disseminated sulfides. Some of the techniques employed in the IP method are reviewed briefly. Evaluation of the method as an exploration technique is based on three points: that the method can be applied so that it reveals the presence and distribution of metallic sulfide minerals without too many false leads, that such information is a guide to economically important mineral deposits, and that the cost is not prohibitive.—E.S.L.

9560 **Roland, George Warren.** Phase relations and geologic application of the system Ag–As–S [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1518B, 1966.

9784 **Rose, Arthur W.** Geological and geochemical investigations in the Eureka Creek and Rainy Creek areas, Mt. Hayes quadrangle, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 20, 37 p., illus., tables, geol. map, 1966.

Rock units in Eureka Creek and Rainy Creek areas include metamorphics of uncertain age, Mississippian or Pennsylvanian volcanics and sediments, Permian Mankomen Formation and Triassic(?) Amphitheatre basalt, argillite, and limestone; all are intruded by plutons of various compositions. Mesozoic and Tertiary deformation resulted in east-west thrust and reverse faults and northeast tear faults, modified by faulting during Tertiary uplift of the Alaska Range. A magnetite skarn east of Maclaren Glacier warrants a magnetometer survey. Copper, copper-nickel, and asbestos shows are present. Of 15 stream sediment anomalies, the most

significant are copper-lead anomalies from streams draining dunite near Rainy Creek and between Broxson Gulch and Landslide Creek in an area bordered by pyritized volcanics.—B.S.H.

9803 **Rose, Arthur W.** Geology of the chromite-bearing ultramafic rocks near Eklutna, Anchorage quadrangle, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 18, 22 p., illus., tables, geol. map, 1966.

A large body of layered peridotite, dunite, and gabbro intrudes volcanics and metasediments along the northwest margin of the Chugach Mts.; discontinuous layering defined by compositional changes and "sedimentary" structures is well developed in many parts. Several major faults cut the body. Chromite showings in dunite in five areas consist of zones up to 20 feet thick averaging 5 to 15 percent Cr_2O_3; they do not appear to have economic importance but further prospecting is suggested. In the arcuate belt-like zone containing scattered ultramafic intrusions along the northwest and north margin of the Kenai-Chugach Mts., further prospecting for metallic deposits and associated ultramafic bodies is recommended. The nickel content of stream sediments and the chromium content of panned sediments are suggested as efficient reconnaissance guides to undiscovered ultramafic intrusions.—*from* Author's abstract

Rosholt, J. N. *See* Dooley, J. R., Jr. 9777

9740 **Ross, H. P.; Lavin, P. M.** In-situ determination of the remanent magnetic vector of two-dimensional tabular bodies: Geophysics, v. 31, no. 5, p. 949-962, illus., table, 1966.

A field technique is described for in-situ determination of the resultant (induced+remanent) magnetic vector of bulk volumes of rock, using a combined analysis of the gravity and magnetic fields of a disturbing body (Poisson's Theorem). The potential fields are adequately sampled easily and quickly in the field by using the geometry of two-dimensional bodies. Results of combined gravity and magnetic surveys over six diabase bodies in the Triassic Basin of Pennsylvania indicate a resultant direction of about D=2°W., I=41° down; the corresponding direction of remanent magnetization is D=1° W., I=28°. The ratio of remanent to induced magnetization is about 2.—D.B.V.

9823 **Ross, J. V.** Geology, Mesa Lake, District of Mackenzie: Canada Geol. Survey Map 1173A (also in Bull. 124), scale 1:63,360, 1965 [1966].

9742 **Ross, John V.** The structure and metamorphism of Mesa Lake map-area, District of Mackenzie, 86 B/14 (west half) [with French, Russian, and German abs.]: Canada Geol. Survey Bull. 124, 39 p., illus., geol. map, 1966.

Mesa Lake area is underlain by the Archean? Yellowknife Group and the Proterozoic Snare Group. The Yellowknife (greywackes, slates, and volcanics) has been deformed into folds that trend northeast and plunge south. Metamorphism raised the rocks to the greenschist facies. Deformation of the Snare (sandstones and shales) produced two sets of folds that trend northeast and northwest and plunge southwest and northwest. The Snare deformation affected the underlying Yellowknife rocks and resulted in steeply plunging folds that are superimposed upon the limbs of the earlier Yellowknife structures. Progressive metamorphism produced rocks from the phyllite-slate grade through schist and gneiss to migmatite. Small bodies of granite were intruded in the last stages of folding. East-west tear faults were formed during final movements. Geological Survey map 1173A is included.—B.S.H.

Ross, Malcolm. *See* Skinner, Brian J. 9778

9578 **Roylance, John G., Jr.** The Dayton iron deposits, Lyon and Storey Counties, Nevada, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. A: Nevada Bur. Mines Rept. 13, pt. A, p. 125-141, illus., 1966.

The Dayton iron deposits are in a mountain pediment 22 mi southeast of Reno; the main orebody forms a low hill. Essentially magnetite bodies with minor pyrite

have replaced folded metasedimentary rocks, considered to be Triassic or Early Jurassic, in which limestone beds were more amenable to replacement than adjacent schists and hornfelses. The main orebody is in an asymmetrical anticline overturned to the east, with a core of granodiorite. Metavolcanic rocks of Jurassic(?) age crop out immediately southwest. Diorite intruding these Mesozoic sedimentary and volcanic rocks is pre-ore in age; quartz monzonite at the main orebody is of post-ore age. The source rock for mineralization is not known for certain but is believed to be the granodiorite.—G.D.C.

9519 **Rubenstein, Sam R.** Petrographic and related physical properties of Navajo Sandstone, Arizona: Eng. Geology, v. 3, nos. 1–2, p. 40–51, illus., tables, 1966.

The relation between petrographic characteristics and physical properties of drill core samples of the Navajo Sandstone at Glen Canyon damsite, is discussed. Considerable range in permeability (3 to 27,000 $ft^3/yr/ft^2$, average 1,860 $ft^3/yr/ft^2$) and porosity (20 to 28 percent, average 24 percent) exists in the rock. The compressive strength of the rock (600 to 6,000 psi, average 3,373 psi) is predominantly controlled by the amount and type of cement. In the Glen Canyon area the typical cement is silica. Atypically hematite and clay occur as adulterants.—M.S.T.

Rucklidge, J. C. *See* Fawcett, J. J. 9826

9761 **Runcorn, S. K.** (editor). Methods and techniques in geophysics, V. 2: London and New York, Interscience Publishers, 314 p., illus., tables, 1966.

This volume is a collection of seven papers discussing techniques in electromagnetic scale modeling, high-pressure experiments, measurement of high-frequency components of the geomagnetic field, use of Fourier methods, methods and apparatus for alternating current and thermal demagnetization, seismic prospecting, and methods of K–Ar age determination on young rocks. Six of the individual papers are cited separately. Extensive reference lists accompany the papers.—V.S.N.

9842 **Rush, F. Eugene; Everett, Duane E.** Water-resources appraisal of Little Fish Lake, Hot Creek, and Little Smoky Valleys, Nevada: Nevada Dept. Conserv. and Nat. Resources Water Resources—Reconn. Ser. Rept. 38, 38 p., illus., tables, 1966.

Younger and older alluvium constitutes the principal ground-water reservoir in Little Fish Lake, Hot Creek, and Little Smoky Valleys in central Nevada. Both volcanic and carbonate rocks in the mountains give rise to major springs. Shallow ground water is utilized for subirrigation in Little Fish Valley and springflow for irrigation elsewhere. Development of ground-water from wells in 1965 was limited to stock and domestic uses. Use of water in phreatophyte areas is the largest form of ground-water discharge in each valley except for subsurface outflow from the southern part of Little Smoky Valley. Additional water is available for development in all valleys; however, the depth to water in excess of 400 feet in the southern Little Smoky Valley limits the type of development presently feasible. Estimated hydrologic elements for each valley are presented in a table.—*from* Authors' abstract

9680 **Rye, Robert O.** The carbon, hydrogen, and oxygen isotopic composition of the hydrothermal fluids responsible for the lead-zinc deposits at Providencia, Zacatecas, Mexico: Econ. Geology, v. 61, no. 8, p. 1399–1427, illus., tables, 1966.

Carbon and oxygen isotopic compositions of calcite show an increase in the heavier isotopes related to a 150°C decrease in temperature. Deuterium concentration is relatively uniform throughout the observed range of temperature and salinity. Calcite and quartz were deposited from fluid with a calculated isotopic composition between 6.4 and 7.9 o/oo δO^{18} relative to the conventional ocean water standard. "The isotopic data strongly point to a magmatic source for the hydrothermal water, and to a deep-seated source for at least 50 percent of the carbon in the calcites." Large salinity variations may reflect intermittent incorporation of sedimentary salt.—W.S.W.

9889 **Sachs, K. N., Jr.** Variability of certain Tertiary larger foraminifera, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 176–177, 1966.

Specimens of larger foraminifera from the San Sebastián formation of the north, and Juana Diaz formation of the south coastal plain of Puerto Rico have aided in clarifying certain subgeneric characters within the genus *Lepidocyclina*. Suites of specimens of *Lepidocyclina (Eulepidina) undosa* Cushman and *L. (E.) yurnagunensis* Cushman demonstrate that these species are highly variable, and distinction between the subgenera *Lepidocyclina and Eulepidina* cannot be based on the appearance of a single feature. Additional material from Cuba, Panama, and the Gulf Coast of the United States suggests that environmental factors may be responsible for the considerable variability within individual species of many of the larger foraminifera. This should result in a reduction in the large number of specific names applied to them in the past.—Author's abstract

9919 **Sámano Pineda, Carmen.** Los suelos de México: México Univ. Nac. Autónoma Anuario Geografía 1965, v. 5, p. 65–125, illus., tables, 1966.

The principles of the genetic processes in development of different soil types and zones are reviewed briefly, and a number of classifications of Mexican soils, made between 1937 and 1964, are grouped to compare nomenclatural differences. The surface areas of the various types found in each state are tabulated. Maps of different years, reproduced here on a scale of about 240 km per in, differ considerably in distribution of soils and in nomenclature; a larger map, 100 km per in, differs from them even more. The effects of erosion and land use are considered by percentage according to climatic zones and physiographic regions.—G.D.C.

9831 **Sandy, John; Carver, Robert E.; Crawford, Thomas J.** Stratigraphy and economic geology of the coastal plain of the central Savannah River area, Georgia—Geol. Soc. America, Southeastern Sec., Field Trip 3, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 30 p., illus., table, 1966.

The guidebook consists of a paper and road log with stop descriptions in an accompanying text. Formations exposed in the area are the Upper Cretaceous Tuscaloosa, lying unconformably on the crystalline rocks, and the overlapping Eocene McBean and Barnwell Formations. Numerous lenticular beds produce a complex stratigraphy. The stop descriptions include measured sections, and descriptions of stratigraphy, fossil oysters, and silicified fossils from the Barnwell Formation. Stops are made at kaolin and fuller's earth pits in the tuff layer at the top of the Tuscaloosa.—E.S.L.

9592 **Saskatchewan Dept. Mineral Resources.** Oil in Saskatchewan: Regina, Saskatchewan, Dept. Mineral Resources, 72 p., illus., 1966.

Chapters of this booklet give a general picture of the exploration, development, and utilization of oil; the history of oil in Saskatchewan; and land tenure, administration, conservation, and opportunities for a career in the oil industry or the government.—E.S.L.

Saunders, J. B. *See* Higgins, G. E. 0059

Savage, Donald E. *See* Camp, Charles L. 0047

Savino, J. *See* vanVeen, H. J. 9924

Sawatzky, P. *See* Washkurak, S. 9718

9514 **Scheidegger, Adrian Eugen.** Isallo stress prospecting: Zeitschr. Geophysik, v. 32, no. 4, p. 183–199, illus., tables, 1966.

Isallo stress lines, describing anomalies in the tectonic stress field of the Earth, provide the basis for a new geophysical prospecting method. An attempt is made to set up a general theory of interpretation of isallo stress anomalies, and examples

are given of its application to stress anomalies in New Zealand, the Rocky Mountain foreland, southern Illinois, the Alps, and the Rhine graben.—D.B.V.

0090 **Schemel, Mart P.** Note on the Laverne Formation: Oklahoma Geology Notes, v. 27, no. 1, p. 15–16, 1967.

In both editions of the *Lexicon of Geologic Names of the United States* (1938,1966), the publication cited as the earliest reference to the Laverne Formation (Gould, 1927) is incorrect. The Laverne Formation was named and described by V. V. Waite in a manuscript that was later quoted by Gould and Lonsdale (1926). This was the only publication of data from the Waite manuscript which was later lost.—B.S.H.

9774 **Schneider, Eric D.; Heezen, Bruce C.** Sediments of the Caicos Outer Ridge, the Bahamas: Geol. Soc. America Bull., v. 77, no. 12, p. 1381–1398, illus., tables, 1966.

The Caicos Outer Ridge, which lies northeast of Caicos Island, consists chiefly of clays evidently deposited by a southeasterly flowing deep ocean current. Four 6-m-long cores taken from 2850 to 2900 fathoms on the ridge and adjacent Hatteras Plain demonstrate a remarkable similarity in stratigraphic sequence and lithology within an elliptical area over 150 miles long. The cores consist predominantly of pelagic clays (illite and chlorite) with interbeds of calcarenite (displaced foraminifera and pteropod tests). Sedimentary structures, the displaced faunas, and anomalous carbonate content indicate deposition as turbidites.—R.G.Y.

Schnepfe, Robert N. *See* Sumner, John S. 9496

9651 **Schnitzer, M.; Skinner, S. I. M.** Organo-metallic interactions in soils—[Pt.] 5, Stability constants of Cu^{++}-, Fe^{++}-, and Zn^{++}-fulvic acid complexes: Soil Sci., v. 102, no. 6, p. 361–365, illus., tables, 1966.

Log K values for Cu-fulvic acid complexes were 5.78 at pH 3.5 and 8.69 at pH 5.0. For Fe-fulvic acid complexes, they were 5.06 at pH 3.5 and 5.77 at pH 5.0, so that in this case pH appeared to have little effect. Log K values for Zn-fulvic acid complexes were 1.73 at pH 3.5 and 2.34 at pH 5.0. The order of stabilities of complexes formed between fulvic acid and Cu^{++}, Zn^{++}, and Fe^{++} were $Cu^{++} > Fe^{++} > Zn^{++}$.—J.W.H.

0083 **Schoonmaker, G. R.** Look before you leap [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 169, 1967.

Schreiber, Edward. *See* Soga, Naohiro. 9897

9561 **Seager, William Ralph.** Geology of the Bunkerville section of the Virgin Mountains, Nevada and Arizona [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1519B, 1966.

9794 **Seal, M.** Inclusions, birefringence and structure in natural diamonds: Nature, v. 212, no. 5070, p. 1528–1531, illus., table, 1966.

The inhomogeneity in natural diamonds may in some cases be caused by alternation of regions of type I (containing nitrogen) and type II (nitrogen-free), but much of it must be a result of more subtle changes in texture. A new structure, not previously studied in detail, is described; it consists of small inclusions occurring in limited regions of certain diamonds. Study of these inclusions and of the birefringence patterns suggests that most type I diamonds are complex mixtures of layers and grains with different concentrations of nitrogen platelets and different concentrations of the impurities reported here, and perhaps with other as yet undetected factors.—D.B.V.

9572 **Searle, Clark Wellington.** Magnetic resonance of pure and doped crystals of hematite [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1592B–1593B, 1966.

9879 **Seeger, Dietrich.** Regional hydrogeology of El Salvador, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 95–97, tables, 1966.

El Salvador has heavy rains of short duration during the wet season with high evaporation rate in many areas. Examples are given of the distribution of rainfall into evaporation, surface runoff, and ground-water discharge. Spring-water temperatures depend upon altitude. Knowledge of exact normal temperature aids in detection of thermal springs, 100 of which are known; and the waters are divided into six groups according to chemistry. Lakes may be divided into six groups according to geologic features. The Republic is divided into six hydrogeologic regions of 25 km-wide strips parallel to the coast. From south to north these are: the coastal plain, coastal chain, central graben, inner highland, interior graben, and frontier highland. The structure and hydrogeology of each is described, especially the central graben which includes 20 percent of the Republic.—E.S.L.

9562 **Sellars, Robert Thompson, Jr.** The geology of the Mena and Board Camp quadrangles, Polk County, Arkansas [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1519B–1520B, 1966.

9656 **Semenov, E. I.; Sørensen, H.** Eudidymite and epididymite from the Ilímaussaq alkaline intrusion, South Greenland [with Russian abs.]: Medd. om Gronland, v. 181, nō. 2, 21 p., illus., tables, 1966.

Eudidymite has been discovered as lamellar or spherulitic aggregates in veins of albitite in alkali granite and poikilitic nepheline-sodalite syenite (naujaite) in the Illímaussaq alkaline intrusion, south Greenland. Epididymite occurs as microcrystalline or fine-grained masses in veins of albitite in naujaite. [A list of the associated minerals in both the vein and naujaite occurrences is given.] The optical properties of the two minerals are: eudidymite: $n\alpha = 1.545$, $n\gamma = 1.549$, $2V\gamma = 25°$; epididymite: $n\alpha = 1.540$, $n\gamma = 1.544$, $2V\alpha = 16–26°$ with a pronounced crossed axial plane dispersion. Chemical analyses of the minerals are recorded. Both minerals are polysynthetically twinned. They were formed during late albitization of naujaite.—*from* Authors' abstract

9888 **Sénesse, Pierre.** Forme originelle et place des formes à replis multiples dans un plan général de classification des Hippurtidés [with English abs.], *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 172–175, illus., 1966.

Pseudovaccinites aquili, of the upper Angoumian in the Corières, France, perhaps represents the ancestral stock of the forms with secondary multiple infolds found in the Antilles, Central America, and the Orient. All through the Angoumian, nine species derive from *Hippurites primordialis*. The author has subdivided Toucas' genus "*Vaccinites*", and created genus *Pseudovaccinites with Pseudovaccinites praepetrocoriensis* Toucas 1904 as type species. This genus includes all the "*Vaccinites*" of Toucas except those of the *sulcatus* group, which are *Hippurites*. In addition to their special characters, the Antillean, Central American, and Oriental forms, with multiple invaginations, show the essential characters of *Pseudovaccinites*, so belong to subgenera which should be placed in that genus.—*from* Author's abstract

Senftle, Frank E. *See* Donnay, Gabrielle. 9864

0053 **Shainberg, I.; Kemper, W. D.** Ion exchange equilibria on montmorillonite: Soil Sci., v. 103, no. 1, p. 4–9, tables, 1967.

According to the standard diffuse double-layer theory, the affinity of clay for the various alkali ions should be the same. Experimentally, it is found that the bonding forces holding the monovalent cations is usually $Cs^+ FK^+ > Na^+ > Li^+$ The amended diffuse double-layer theory proposed by the authors, combined with the ion-pair formation concept, was used to predict equilibrium constants for the monovalent ions adsorbed on montmorillonite clay. Predicted and measured values of the equilibrium constants were in good agreement, except when Cs^+ was one of the

cations. Apparently, forces in addition to coulombic and induced dipole forces causes adsorption of Cs^+ to the clay.—J.W.H.

Shapiro, Irwin I. *See* Colombo, Giuseppe. 9834

9838 **Shapiro, Irwin I.; Lautman, Don A.; Colombo, Giuseppe.** The Earth's dust belt, fact or fiction?—[Pt.] 1, Forces perturbing dust particle motion: Jour. Geophys. Research, v. 71, no. 23, p. 5695–5704, illus., 1966.

The predominant nongravity force influencing the motion of small dust particles orbiting near the Earth and in interplanetary space is that of sunlight. Far from the Earth the only other force that may be of significance is the Lorentz force, whereas near the Earth all the usual forces included in analyzing satellite orbits become important. In this series of papers combinations of forces that may contribute substantially to a concentration of such dust around the Earth are analyzed. The results indicate that an increase of flux near the Earth of only about a factor of 10^2 over the interplanetary value is understandable, and that a factor well less than 10 is most reasonable.—D.B.V.

Shapiro, Irwin I. *See* Colombo, Giuseppe. 9839

Shapiro, Irwin I. *See* Lautman, Don A. 9840

0095 **Shepard, William M.** Geochemical prospecting spurs further research, *in* The search for ore: Mining Eng., v. 19, no. 2, p. 67–69, illus., 1967.

Geochemical prospecting research and field applications continued on a variety of fronts. There was increasing realization that better criteria must be developed for the appraisal of geochemical anomalies. Interest in mercury as a pathfinder element continued although perhaps with somewhat diminished enthusiasm.—F.C.C.

9537 **Sherwood, W. C.; Fiedler, F. J.** Another look at the Betts quarry problem [abs.], *in* Virginia Acad. Sci. Proc. 1965–66: Virginia Jour. Sci., new ser., v. 17, no. 4, p. 321–322, 1966.

Shirley, Ray. *See* Fischer, Irene. 9502

9795 **Shreve, Ronald L.** Sherman landslide, Alaska: Science, v. 154, no. 3757, p. 1639–1643, illus., tables, 1966.

Triggered by the earthquake of 28 March 1964, 3×10^7 cu m of rock fell 600 m, then slid at high speed 5 km across the nearly level Sherman glacier near Cordova. The landslide has a number of significant new features in addition to those typical of other large landslides that may have slid on a layer of trapped and compressed air.—Author's abstract

Shrewsbury, R. D. *See* Moore, B. J. 9817

9563 **Sigsby, Robert J.** "Scoria" of North Dakota [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1520B, 1966.

9764 **Sinclair, G. W.** Alice Evelyn Wilson, 1881–1964: Royal Soc. Canada Minutes Proc. 1966, 4th ser., v. 4, p. 117–121, portrait, 1966.

Sioda, R. *See* Donnay, Gabrielle. 9864

9778 **Skinner, Brian J.; Jambor, John L.; Ross, Malcolm.** Mckinstryite, a new copper-silver sulfide: Econ. Geology, v. 61, no. 8, p. 1383–1389, tables, 1966.

Mckinstryite, $Cu_{0.8+x}Ag_{1.2-x}S$, where $O\leq X\leq 0.02$, was found on a specimen collected in 1907 at the Foster Mine, Cobalt, Ont. Mckinstryite is orthorhombic, space group *Pnam* or $Pna2_1$, $a=14.043\pm0.005$A, $b=15.677\pm0.006$A, and $c=7.803\pm0.003$A, $Z=32$, specific gravity 6.61 ± 0.03. Strongest X-ray powder diffraction lines are 2.606A(10), 2.070A(7), 3.062A, 3.508A, 2.862A, 1.948A(5), 2.407A(4), and 2.567A(4). Mckinstryite is named in honor of Hugh Exton

McKinstry, 1896–1961, late Professor of Economic Geology, Harvard University.—Authors' abstract

9637 **Skinner, John W.; Wilde, Garner L.** Type species of *Pseudofusulina* Dunbar and Skinner: Kansas Univ. Paleont. Contr.—Paper 13, 7 p., illus., 1966.

A restudy of the type specimens of *Pseudofusulina huecoensis* Dunbar and Skinner, the type species of the genus *Pseudofusulina* Dunbar and Skinner, shows that all of these specimens display the characters considered diagnostic of *Rugosofusulina* Rauser-Chernoussova. Because *Pseudofusulina* has a priority of some six years over *Rugosofusulina*, the latter must be regarded as a junior synonym.—Authors' abstract

Skinner, S. I. M. *See* Schnitzer, M. 9651

9844 **Skvarla, John J.** Addendum to "Techniques of pollen and spore electron microscopy—Pt. 1, Staining, dehydration, and embedding" [1966]: Oklahoma Geology Notes, v. 26, no. 12, p. 285, 1966.

Critical application of the catalyst DMP-30 for embedding with Araldite-Epon resins was emphasized in the original paper. As DMP-30 undergoes considerable changes with aging, it was recommended that test samples be made prior to exine bedding to determine the correct proportion of catalyst needed. The more fluid catalyst BDMA, which has a considerably longer storage life and more stable properties, can be substituted for DMP-30. For most work, 6 to 8 drops of BDMA per 4 ml of Araldite-Epon will produce satisfactory blocks for thin sectioning.—B.S.H.

Sloan, Robert E. *See* VanValen, Leigh. 9493

9581 **Slosson, James E.; Cilweck, Blase A.** Parson's Landing landslide—A case history including the effects of eustatic sea level changes on stability: Eng. Geology, v. 3, nos. 1–2, p. 1–9, illus., 1966.

Parson's Landing landslide, along the northwestern shore of Santa Catalina Island, is an elevated block-faulted horst some 20 miles offshore from Los Angeles in a region of submarine block-fault topography. Major slippage or failure occurred in the region during Late Pleistocene in post-Mankato and pre-Recent time. One of the sea cliffs and wave-cut benches which formed during lower sea level at the end of the Mankato-sub-glacial stage now lies 50 feet under water near the landslide, and apparently forms a zone of weakened lateral support in the area. The original slippage was apparently associated with the submerged cliff, the relatively weak, shattered Franciscan bedrock, a rise in sea level, and associated rise in the water table, allowing saturation of the bedrock, high precipitation rate, and possibly seismic activity.—M.S.T.

9768 **Smith, A. Gilbert; Barnes, William C.** Correlation of and facies changes in the carbonaceous, calcareous, and dolomitic formations of the Precambrian Belt-Purcell Supergroup: Geol. Soc. America Bull., v. 77, no. 12, p. 1399–1426, illus., tables, 1966.

The supergroup has four divisions, which in the United States from the base upward are the Pre-Ravalli sequence, and Ravalli, Piegan, and Missoula Groups, based on the following correlations: The lower eastern carbonate-bearing sequence (Fort Steele, Altyn and Waterton, and Newland Formations) intertongues westward into carbonate-poor but carbonaceous strata (Aldridge and Prichard Formations). The upper eastern carbonate-bearing sequence (Siyeh and Helena Formations) correlates with the western carbonate-bearing sequence (Kitchener, Kitchener-Siyeh of British Columbia; Wallace, Idaho and Montana; and "Newland", Montana). Two cycles of finely laminated siltite are recognized, each with a lower black to gray, carbonaceous cycle (Pre-Ravalli sequence and Piegan Group) and an upper reddish hematitic cycle (Ravalli and Missoula Groups).—R.A.L.

Smith, C. W. *See* Balsley, J. R. 0099

Smith, C. W. *See* Balsley, J. R. 0101

Smith, C. W. *See* Balsley, J. R. 0103

Smith, C. W. *See* Philbin, P. W. 9693

Smith, C. W. *See* Philbin, P. W. 9694

Smith, C. W. *See* Philbin, P. W. 9695

Smith, C. W. *See* Philbin, P. W. 9696

9564 **Smith, Richard Elbridge.** Petrographic properties influencing porosity and permeability in the carbonate-quartz system as represented by the Gatesburg Formation [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1521B, 1966.

9536 **Smyth, J. R.; Bell, R. T.** Luminescence petrography at V.P.I.—A preliminary report [abs.], *in* Virginia Acad. Sci. Proc. 1965–66: Virginia Jour. Sci., new ser., v. 17, no. 4, p. 321, 1966.

Smyth, Joseph R. *See* Bell, R. Thomas. 9529

9897 **Soga, Naohiro; Schreiber, Edward; Anderson, Orson L.** Estimation of bulk modulus and sound velocities of oxides at very high temperatures: Jour. Geophys. Research, v. 71, no. 22, p. 5315–5320, illus., table, 1966.

Bulk modulus and sound velocities of oxides and silicates up to very high temperatures are estimated from experimental data on sound velocity obtainable at relatively low temperatures. Data are given for MgO, Al_2O_3, and Mg_2SiO_4. The theoretical basis for the method is a linear dependence of bulk modulus on temperature at elevated temperatures established by use of the Mie-Grüneisen equation of state. The parameters required are room-temperature values of bulk modulus, density, thermal expansion, Grüneisen constant, and measured enthalpy as a function of temperature. The velocity variations with temperature are determined from the calculated variation of bulk modulus and shear modulus with temperature.—D.B.V.

9620 **Solem, Allan.** Morphological changes associated with vitriniform and succineiform shells and their bearing on gastropod classification [abs.], *in* Abstracts of papers related with biology—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 5: Tokyo, Sci. Council Japan [Sec. 11], p. 57, 1966.

Sørensen, H. *See* Semenov, E. I. 9656

9907 **Spencer, W. K.; Wright, C. W.** Asterozoans, *in* Treatise on invertebrate paleontology—Pt. U, Echinodermata 3, V. 1: New York, Geol. Soc. America (and Univ. Kansas Press), p. U4–U107, illus., 1966.

The well delimited subphylum Asterozoa (182 fossil, 556 Recent genera) consists of the single class Stelleroidea (star-shaped, free living forms) divided into the subclasses Somasteroidea, Asteroidea, and Ophiuroidea. Though all the subclasses range from Lower Ordovician to Recent, the Somasteroidea (7 fossil, one Recent, genera) are considered ancestral to the asteroids and ophiuroids. Sections on general features, morphology and function, ontogeny, phylogeny, and classification precede the systematic descriptions, which include diagnoses to the generic level (omitted for many exclusively Recent genera), complete nomenclature, and illustrations of type species and additional fossil species.—V.M.J.

0081 **Spiva, Frank; Doss, A. K.** Palo Pinto Limestone of western Runnels County, Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 168–169, 1967.

9762 **Sproule, J. C.** George Sherwood Hume, 1893–1965: Royal Soc. Canada Minutes Proc. 1966, 4th ser., v. 4, p. 95–96, portrait, 1966.

9609 **Srivastava, Satish K.** Upper Cretaceous microflora (Maestrichtian) from Scollard, Alberta, Canada [with French abs.]: Pollen et Spores, v. 8, no. 3, p. 497–552, illus., 1966.

Pollen and spores have been recovered from sediments of the Middle and Upper Members of the Edmonton Formation of Maestrichtian age from three localities in the Scollard area of Alberta, spanning a mammal bearing horizon. Ninety species belonging to 59 genera are described; organ genera represent one natural family of bryophytes, nine of pteridophytes, five of gymnosperms, and 18 of angiosperms; in addition, numerous form genera of uncertain position are described. Five new genera and 17 new species are proposed and named. The new genera are: *Ghoshispora* (pteridophyte, form genus); *Salixipollenites, Carpinipites, Cranwellia* (angiosperms, organ genera of Salicaceae, Betulaceae, Loranthaceae); *Scollardia* (angiosperm, form genus).—V.M.J.

9836 **Staley, D. O.** Temperatures of meteoroids and meteorites: Jour. Geophys. Research, v. 71, no. 23, p. 5681–5687, table, 1966.

The effects of emissivity, absorptivity, and thermal inertia are taken into account in the calculation of meteoroid temperatures at the Earth's distance from the Sun. Iron meteoroids at 1 AU with equivalent sphere radii in excess of about 1.5 m may have temperatures departing substantially from radiative equilibrium temperatures as they move toward or away from the Sun in highly eccentric orbits. The radiative equilibrium temperature of stone meteoroids is less than O°C, whereas for iron meteoroids, it is substantially greater than O°C. These results are consistent with observed temperatures of newly fallen meteorites.—Author's abstract

9524 **Stasek, Charles R.** Environmental factors in the evolution of monomyarian bivalved Mollusca [abs.], *in* Abstracts of papers related with biology—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 5: Tokyo, Sci. Council Japan [Sec. 11], p. 8, 1966.

9833 **Stauder, W. M.; Bollinger, G. A.** The focal mechanism of the Alaska earthquake of March 28, 1964 and of its aftershock sequence: Jour. Geophys. Research, v. 71, no. 22, p. 5283–5296, illus., table, 1966.

Focal mechanisms are given for one preshock, the main shock, and more than 25 aftershocks of the 1964 Alaska earthquake. For the main shock a single nodal plane with a strike azimuth of 66°, dip 85° SE, is determinable from P-wave polarity; this plane could be a plane normal to the fault motion (thrust faulting), or the fault plane (dip-slip motion on a near-vertical plane). One nodal plane of the aftershocks closely resembles the nodal plane of the main shock, the other dips 5°–15° to the NW or north. Criteria favoring a thrust hypothesis are advanced. From dislocation theory it is shown that differential slip and/or a dipping thrust plane explain satisfactorily the observed vertical displacements at the surface.—D.B.V.

9750 **Stearn, C. W.** Upper Devonian stromatoporoids from southern Northwest Territories and northern Alberta [with French abs.]: Canada Geol. Survey Bull. 133, p. 35–68, illus., tables, 1966.

Devonian outcrops on the Peace River at Vermilion Chutes and Gypsum Cliffs, Alberta, in the region of Waterways, Alberta, and west of Great Slave Lake, Northwest Territories, have yielded a rich stromatoporoid fauna. Two distinct faunas are recognized. A lower fauna, here called the *Ferestromatopora parksi* fauna, occurs in the Hay River, Twin Falls, and Mikkwa Formations. The Kakisa Formation carries the upper *Stictostroma maclareni* fauna. Twenty species are described of which eight are new and three are identified provisionally.—B.S.H.

9688 **Stearns, Harold T.** Geology of the State of Hawaii: Palo Alto, Calif., Pacific Books, 266 p., illus., tables, 1966.

This book is an expansion of *Geology of the Hawaiian Islands* (Stearns, 1946) and includes text abstracted from the geology and geomorphology studies published in eleven volumes of the Hawaiian Division of Hydrography. It presents previously

unpublished geophysical data on the structure of the crust under this chain of shield-shaped domes that began rising at least 25 m.y. ago from a fissure 1,600 mi long in the ocean floor. Written for both geologists and laymen interested especially in volcanoes, it gives locations of ancient vents which form the now deeply eroded islands, carbon-14 dates of fossils, petrology, chemistry, and geophysical properties of the lavas, and mineral and water resources. The geologic history of each island is presented in separate chapters.—G.D.C.

9573 **Stebbins, Robert H.** Integrated exploration techniques, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. A: Nevada Bur. Mines Rept. 13, pt. A, p. 15–22, 1966.

Successful integrated exploration programs require imaginative leadership, diversified technical competence, large budgets, and good luck. Emphasis is given here to geologic mapping and compilation supported by contemporary remote sensing devices. Photogrammetric, airborne and ground geophysical, geochemical, data processing, and drilling techniques are discussed. The role of research and development is accentuated, including geologic research. The limitations of contemporary mineral exploration techniques are emphasized, as well as their benefits. Mention is made of costs, personnel, administrative, and legal aspects of the methods required in integrated exploration programs. Areas of research are suggested which may contribute to better exploration techniques and programs in the future.—Author's abstract

Stemmler, R. S. *See* Graf, D. L. 0050

9643 **Stephenson, E. L.** Raw materials for the Nevada Cement Company plant at Fernley, Nevada, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. B: Nevada Bur. Mines Rept. 13, pt. B, p. 45–50, illus., 1966.

For the new cement plant at Fernley, gypsum is delivered from a mine at Empire, Nev.; limestone and clay are mined from newly developed deposits close to the plant; high-grade iron ore is supplied from Minnesota and a concentrator near Wabuska, Nev. The Fernley limestone deposit of Late Tertiary age, deposited in a fresh water lake during a local interlude in a dominantly volcanic epoch, is described; also the Marble Bluff limestone 22 miles to the north which is a block-faulted mountainous inlier of Triassic(?) marine limestone and dolomite. In addition to the mined Fernley clay, extensive deposits of kaolin clays north of Pyramid Lake are held in reserve. This area, 55 miles by road from the plant, is underlain by Tertiary volcanic rocks, in which the clays, in thick beds over a considerable range of altitude, are the product of lateritic weathering and hydrothermal alteration.—G.D.C.

Stermac, A. G. *See* Lo, K. Y. 9483

Strangway, D. W. *See* Gross, W. H. 9730

9513 **Strangway, David W.** Electromagnetic parameters of some sulfide ore bodies, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 227–242, illus., table, 1966.

A series of model experiments has been carried out as an aid to the interpretation of horizontal-loop (Slingram) electromagnetic surveys. The model used was a large conducting sheet with various orientations subjected to various frequencies. It is shown how it is possible to derive the dip, depth, and conductivity-thickness product of such bodies. The interpretation procedure has been applied to a set of field data and it is concluded that the conductivity-thickness product is a useful parameter in the study of massive-sulfide deposits. These examples show that many sulfide conductors have conductivity-thickness products between 1 and 30, a surprisingly small range considering the possible range of values for conductivity and for thickness in natural deposits.—Author's abstract

9516 **Strangway, David W.** Rock magnetism and geologic correlation, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 54–66, illus., tables, 1966.

Rock magnetism, acquired when the rock was formed, is applied as a correlation tool in a few geologic problems. One example used is the younger Precambrian dikes in the Canadian Shield. Six swarms in Ontario, Quebec, and Michigan were identified and 186 samples collected. Both the direction of paleomagnetism and ratio of permanent to induced magnetization gave distinct criteria for classifying the dikes. The Sudbury basin is shown by this technique to be an intrusion which was folded later; the Monteregian intrusives show a Cretaceous pole position; and Miocene lava flows of Oregon can be separated by using reversals as horizon markers.—E.S.L.

9755 **Strangway, David W.** Electromagnetic scale modeling, *in* Methods and techniques in geophysics, V. 2: London and New York, Interscience Publishers, p. 1–31, illus., tables, 1966.

Principles and techniques of electromagnetic modeling are given, particularly for application to practical exploration problems where a knowledge of responses of various configurations can lead to semi-quantitative interpretations. Modeling conditions, parameters, and configurations to be modeled are examined. For the latter, a brief discussion of the more common source and receiver configurations is given before discussion of the various forms (buried sphere, cylinder, layered or homogeneous half-space, semi-infinite plane, and disc). A list of 31 references is included.—V.S.N.

Strangway, David W. *See* Larson, Edwin E. 9827

0106 **Strausberg, S. I.** Estimating distances to hydrologic boundaries from discharging well data: Ground Water, v. 5, no. 1, p. 5–8, illus., 1967.

Estimates can be made of the distances to hydrologic boundaries by using water-level measurements from pumping wells and by assuming in each case the possible range of the coefficient of storage. Interpretation of pumping test data from Well 6(J–13) at the Nevada Test Site implies that a fault 1,200 feet from the well acts as the closest of the impermeable boundaries. In a case where no boundary has been felt the areal extent or volume of rocks affecting the downdraw pattern of a well can be estimated by assuming that a hypothetical boundary is just about to be felt at the time pumping stopped.—Author's abstract

9565 **Street, James Stewart.** Glacial geology of the eastern and southern portions of the Tug Hill Plateau, New York [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1521B–1522B, 1966.

0107 **Summers, W. K.; Brandvold, L. A.** Physical and chemical variations in the discharge of a flowing well: Ground Water, v. 5, no. 1, p. 9–10, illus., table, 1967.

Observations of temperature, pH, specific conduction, and discharge, and concentrations of calcium, magnesium, potassium, lithium, and sodium, in the discharge of a flowing well reveal that geochemistry of aquifers should be based on sample wells which have been allowed to discharge for an extended period.—Authors' abstract

Sumner, J. S. *See* Maillot, E. E. 9722

9496 **Sumner, John S.; Schnepfe, Robert N.** Underground gravity surveying at Bisbee, Arizona, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 243–251, illus., table, 1966.

During the past 15 years Phelps Dodge Corp. has actively used underground gravity surveying at Bisbee. The method has proven useful for locating and assisting in the development of massive sulfide bodies. Host rocks are fairly uniform in density, 2.65 to 2.70 gm/cm^3, while average densities of sulfide bodies reach as high as 4.00 gm/cm^3, providing a strong contrast. [After necessary corrections] residual gravity values are plotted on level plan maps and these values are contoured. Likely positive and negative anomalies are recommended for drilling. Vertical sections of gravity data are prepared from level maps. They are contoured and then interpreted to give a measure of "apparent density" by relating vertical gravity gradient to density.

Examples of an underground gravity map and sections are given.—*from* Authors' abstract

9709 **Sutherland, Alexander J.** Entrainment of fine sediments by turbulent flows: California Inst. Technology, W. M. Keck Lab. Hydraulics and Water Resources Rept. KH-R-13, 199 p., illus., tables, 1966.

A study was made of the means by which turbulent flows entrain sediment grains from alluvial streams, including both initiation of sediment motion and suspension of grains by the flow. A pulsating jet was used to simulate the flow conditions in a turbulent boundary layer. Dimensional analysis was used to determine the parameters by which experimental data could be correlated. In the laboratory flume dye injection was used to show the intermittent nature of the sublayer and the velocities with vertical components adjacent to the sediment bed. It is suggested that the impingement of turbulent eddies onto a sediment bed, while not the only mechanism by which grains can be entrained, does play a dominant role in the process.—G.D.C.

9648 **Swanson, Roger A.; Hovland, Dwight; Fine, L. O.** Fluorometric determination of magnesium in soil extracts: Soil Sci., v. 102, no. 4, p. 244–247, tables, 1966.

Magnesium concentrations in neutral N NH_4OAc and saturation extracts of soils were determined successfully by fluorescence with o, o'-dihydroxyazobenzene. A small volume of soil extract was mixed directly with the reagent and fluorescence measured immediately. The Mg concentrations determined fluorometrically compared favorably with those obtained by other analytical methods.—J.W.H.

9748 **Swift, Donald J.** The Black Creek–Peedee contact in South Carolina: South Carolina Div. Geology Geol. Notes, v. 10, no. 2, p. 17–36, illus., 1966.

The interstratified sands and clays of the upper Black Creek Formation, Pee Dee River valley, are transition zone strata deposited on the floors and margins of restricted bodies of water dominated by tidal regimens. Lenses of clean sand at the top of the Black Creek are remnants of littoral and nearshore sand bodies. The muddy sands of the overlying Peedee Formation were deposited on the open shelf. The Peedee–Black Creek contact is a ravinement or disconformity cut by the surf zone of the transgressing Peedee sea. In North Carolina its time value is negligible. In South Carolina the *Exogyra cancellata* subzone of the lower Peedee may be missing; if so the ravinement process may have been complicated by diastrophism or may simply have occurred at a slightly later time.—Author's summary

9678 **Symons, D. T. A.** A paleomagnetic study on the Gunflint, Mesabi, and Cuyuna iron ranges in the Lake Superior region: Econ. Geology, v. 61, no. 8, p. 1336–1361, illus., tables, 1966.

Stable primary chemical remanent magnetism of the Gunflint, Biwabik, and Deerwood iron formations from the Gunflint, Mesabi, and Cuyuna Ranges, respectively, yields a more or less common pole position of 94° W., 28° N., suggesting that they are essentially contemporaneous. The period of deposition of the Gunflint includes a reversal episode and may have been fairly long. The polarity of chemical remanent magnetism of soft ores of the Mesabi and Cuyuna Ranges suggests that they were formed by Mesozoic–Cenozoic weathering.—W.S.W.

Tabor, Lawrence L. *See* Page, Benjamin M. 0066

0062 **Tanner, J. Henry, 3d.** Wrench fault movements along Washita Valley fault, Arbuckle Mountain area, Oklahoma: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 126–134, illus., table, 1967.

The major movement of the Washita Valley fault is strike-slip, and the left-lateral offset of the Simpson facies, about 40 miles, is a partial measure of the displacement. The main movement probably occurred prior to the major Arbuckle orogeny and perhaps as early as the Wichita orogeny.—W.C.C.

0063 **Taylor, Frank B.** Outlook for shallow oil exploration and development, United States: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 1, p. 134–141, illus., table, 1967.

The possibility of finding oil in the United States at depths less than 2,000 feet are good. There remain substantial shallow areas to be explored, proved regions to be more densely drilled, and new concepts to be applied in the "deep" areas where shallow oil may have been missed. Logs of old wells are an important tool in this search.—W.C.C.

9523 **Taylor, Roy L.** The Queen Charlotte Islands—A plant refugium of the eastern Pacific [abs.], *in* Abstracts of papers related with biology—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 5: Tokyo, Sci. Council Japan [Sec. 10], p. 43, 1966.

9566 **Teeter, James Wallace.** The distribution of Recent marine ostracodes from British Honduras [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1522B, 1966.

9522 **Terasmae, J.** Notes on Quaternary paleoecological problems in the Yukon Territory, Canada, and adjacent regions [abs.], *in* Abstracts of papers related with biology—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 5: Tokyo, Sci. Council Japan [Sec. 6], p. 4, 1966.

9605 **Terlecky, P. Michael.** The clay minerals of a traverse on the North Carolina continental margin and Bermuda Rise: Southeastern Geology, v. 7, no. 4, p. 141–150, illus., tables, 1966.

Semiquantitative mineral analysis of the <2 micron size fraction of 18 gravity cores from the North Carolina Continental Margin and Bermuda Rise reveals that montmorillonite and illite are the dominant clay minerals with kaolinite and chlorite constituting most of the remainder of the clay fraction. Quartz, feldspar, and mixed-layer material are also present. Glauconite appears to form an important portion of upper slope "illite group" clay minerals. Montmorillonite and kaolinite decrease seaward while illite and chlorite increase. Origin of these minerals appears to be as continental detritus with long distance oceanic transport playing a role. A new parameter, the "c/k ratio" (index of relative development of the kaolinite–chlorite peaks at 3.5A) provides an additional means of observing possible changes taking place in chlorite abundance and/or crystallinity.—Author's abstract

9629 **Terlecky, P. Michael.** Marine geology of the Georgia continental shelf [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 82, no. 2, p. 93, 1966.

9758 **Thellier, E.** Methods and apparatus for alternating current and thermal demagnetization, *in* Methods and techniques in geophysics, V. 2: London and New York, Interscience Publishers, p. 205–247, illus., 1966.

The analysis of natural remanent magnetization or, where the main purpose is to find the original remanence, magnetic 'cleaning' is examined under the following headings: basis of analysis of natural remanences, detection of viscous remanent magnetization, analysis of action of alternating fields, and thermal analysis. A reference list of 58 entries is included.—V.S.N.

Thomas, Herman H. *See* Lidiak, Edward G. 9767

Thompson, C. D. *See* Quigley, R. M. 9735

9717 **Thompson, J. C.** Fred and George Creek Field, Toole County, Montana, *in* Symposium, Jurassic and Cretaceous stratigraphic traps, Sweetgrass arch—Billings Geol. Soc., 17th Ann. Field Conf. 1966, Guidebook: Billings, Mont., Billings Geol. Soc., p. 178–185, illus., 1966.

The oil field is located in Toole County just south of the Canadian boundary, on the east flank of the Sweetgrass arch. The producing sands, all in the Cretaceous Kootenai Formation, are very lenticular; present production is about 4,500 bbls per day. Three isopach maps are included.—E.S.L.

9655 **Thomson, Robert.** Geology of the Henwood township, District of Timiskaming: Ontario Dept. Mines Misc. Paper 5, 48 p., illus., tables, geol. map, 1966.

Bedrocks exposed in Henwood township include the Lorrain and Firstbrook Formations of the Huronian Cobalt Group, the Nipissing diabase sill, and Keweenawan diabase dikes. The Stone-Eplett No. 3 diamond drill core (4,050 feet) penetrated much of the Lorrain and Firstbrook Formations and the entire thickness of the Nipissing sill. The petrology and origin of these units are discussed in some detail. A brief account of the glacial geology is given. The only important economic resources are large amounts of sand, gravel, and ballast obtainable from the glaciofluvial deposits in the northern part of the area. Although the township lies in the Timiskaming silver-cobalt area, prospecting has failed to discover metalliferous deposits. A geologic map is included.—B.S.H.

Thorpe, A. N. *See* Donnay, Gabrielle. 9864

9776 **Tiffin, D. L.; Murray, J. W.** Mapping offshore shelf with continuous seismic: Oilweek, v. 17, no. 38, p. 48, 50–51, illus., 1966.

Operation of a continuous seismic profiler from a boat is reviewed briefly, and two profiles run in the Strait of Georgia by the Univ. of British Columbia are described and illustrated. The southern profile, which crossed the Fraser River delta front, reveals Cretaceous bedrock covered by flat-lying strata of possible Pleistocene age, in turn overlain by the Recent sediments of the delta. The northern profile illustrates basin and ridge topography, with deposition in the basins; the Quaternary here is much thinner than in the delta area.—E.S.L.

9780 **Tóth, J.** Groundwater geology, movement, chemistry and resources near Olds, Alberta: Research Council Alberta Bull. 17, 126 p., illus., tables, 1966.

Exploration to alleviate a water shortage problem in this central Alberta farming community located a ground-water reserve 5 mi southeast, estimated to yield 375 igpm for 20 years, and another of smaller capacity about 4 mi northeast of the town. Detailed investigations resulted in discovery of a volcanic ash bed which may be a useful Tertiary marker, a system of buried bedrock channels, evidence for faulting in Tertiary strata, and evidence of a strong lithologic similarity between rock units believed to be of late Cretaceous and early Tertiary ages. One regional and five local flow systems have been outlined; two anomalies are caused by an impermeable barrier and by a rock unit of relatively high permeability. Areas of different bicarbonate types of water are well separated; total solids increase in direction of flow.—G.D.C.

Townsend, D. L. *See* Hughes, G. T. 9484

9567 **Travis, Patricia Ann Asiala.** An analysis of Pleistocene sediments in an aquifer recharge area, Kalamazoo, Michigan [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1522B, 1966.

9852 **Tricart, Jean.** Aplicaciones de la geomorfología en las obras de ingeniería y especialmente en los estudios agrológicos, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 3–10, 1966.

Geomorphology is defined with emphasis on the evolution of earth forms as affected by geologic history, tectonic and volcanic manifestations, gravity, weathering, changes in rock characteristics, and genesis of soils. Its principles are of importance in various engineering construction plans as well as for agricultural problems. Indirect applications involve soil erosion and creep, terraces, and ecology.—G.D.C.

Truyols Santonja, J. *See* Crusafont-Pairó, M. 9518

9821 **Tucker, M. J.** Sideways looking sonar for marine geology: Geo-Marine Technology, v. 2, no. 9, p. 18–23, illus., 1966.

Sideways-looking sonars produce acoustic pictures of the surface of the sea-bed, and existing instruments with ranges up to about 1,500 m have shown this to be a tool of major importance to marine geology. The main part of the paper discusses the principles and design factors of sideways-looking sonars with main reference to their use in continental shelf areas. Brief mention is made of the problems involved in designing such a sonar for use in the deep sea.—Author's abstract

Turek, A. *See* McIntyre, G. A. 9737

9912 **Ubaghs, Georges.** Ophiocistioids, *in* Treatise on invertebrate paleontology—Pt. U, Echinodermata 3, V. 1: New York, Geol. Soc. America (and Univ. Kansas Press), p. U174–U188, illus., 1966.

The Ophiocistioidea are a small class (four genera in three families, plus one questionable family and genus) of pentaradiate free-moving echinozoans known only from lower Paleozoic strata. The test resembles that of echinoids, but the junction of the plates is different. The animal rested on the flat oral surface and traveled about by means of hollow tubular organs covered by small imbricated plates, which superficially resemble the long arms of ophiuroids but, despite their relatively large size, are interpreted as ambulacral tube feet. The ophiocistioids comprise an entirely separate class of unknown origin, characterized by juvenile features resembling those of Recent free-living echinoderms shortly after metamorphosis, having on the whole greater similarities to echinoids than to asterozoans.—V.M.J.

9615 **Ugolini, F. C.** Soils of the Mesters Vig district, Northeast Greenland—[Pt.] 1, The Arctic Brown and related soils: Medd. om Grønland v. 176, no. 1, 22 p., illus., tables, 1966.

The presence of Arctic Brown soil in Greenland is a link between the North American and Eurasian continents and establishes the Arctic Brown as a circumpolar soil. It has been estimated that the Arctic Brown soil at Mesters Vig covers about 10 percent of the area. The distribution and properties of this soil depend on drainage, texture of the substratum, stability of the site, and time. Physical and chemical data for a typical Arctic Brown indicate an accumulation of fines at the surface, an acid reaction, a concentration of organic matter at the surface, and an even distribution of free iron oxides throughout the profile. Podzol-like and Arctic Brown soils coexist in the district. An idealized latitudinal sequence of the zonal soils of the ice-free areas of Greenland should show from south to north the succession from Podzols to Arctic Brown to Polar Desert soils.—*from* Author's abstract

9616 **Ugolini, F. C.** Soils of the Mesters Vig district, Northeast Greenland—[Pt.] 2, Exclusive of Arctic Brown and Podzol-like soils: Medd. om Grønland, v. 176, no. 2, 25 p., illus., 1966.

The soils of Mesters Vig described include Lithosols, Meadow and Upland Tundra, Tundra variant, Protoranker, and Tundra Ranker soils. A single profile description is given for each, together with a discussion of the factors affecting the soil morphological properties. The cryopedogenic and gelifluction processes are very important. Certain megascopic properties may be indicative of stability on soil slopes, while miniature and shallow profiles in patterned ground may provide information on the cryopedogenic processes. Because arctic soils are shallow and not well developed, they are sensitive to small climatic changes and other disturbances, so soil distribution and development reflect the dynamic effect of arctic landscape.—*from* Author's abstract

9785 **Ugolini, Fiorenzo C.** Soils, Pt. 3 *in* Soil development and ecological succession in a deglaciated area of Muir Inlet, southeast Alaska: Ohio State Univ. Inst. Polar Studies Rept. 20, p. 29–72, illus., tables, 1966.

A sequence of ecosystems has developed in the Glacier Bay area along the deglaciation stages that began at the end of the Little Ice Age. A pedological study along a transect from the terminus of Casement Glacier to the terminal moraine of Bartlett Cove has revealed a number of soils whose historical sequence corresponds to the ontogeny of a Podzol. The Podzols found at the end of the

recessional sequence are shallow and lack both an illuvial humus and a clay horizon. Turf-hummocks and other patterned ground features occur above 900 m. Frozen ground was also detected in the turf-hummock areas.—*from* Author's abstract

9856 **Unklesbay, A. G.** Variation in an *Eothalassoceras* from the Seminole Formation, Oklahoma: Oklahoma Geology Notes, v. 26, no. 12, p. 283–284, illus., 1966.

A well preserved specimen of *Eothalassoceras inexpectens* has been collected from nodules above the Dawson coal in the Seminole Formation [Pennsylvanian, Tulsa County.] This specimen is similar to those previously described from this same locality but it differs slightly in details of the sutures. In this specimen the lobe at the umbilicus is nondigitate whereas in specimens of *E. inexpectens* previously described it is weakly digitate. In this respect this specimen is similar to *E. caddoense* but differs from that species in being somewhat more globose and less discoidal.—*from* Author's abstract

Upadhyay, R. N. *See* Fatt, I. 9708

9710 **U.S. Bureau of Mines.** List of Bureau of Mines publications and articles, January 1 to December 31, 1965, with subject and author index: U.S. Bur. Mines Spec. Pub., 89 p., 1966.

9639 **VanderStoep, D. M.** Velocity anisotropy measurements in wells: Geophysics, v. 31, no. 5, p. 900–916, illus., tables, 1966.

Anisotropy in seismic wave propagation, generally exhibited by sedimentary rocks, can be defined as the difference between propagation time predicted by Snell's law and that observed between two points in a layered medium on a line oblique to the layers. In reflection seismology the effect of anisotropy can generally be described geometrically by an anisotropy factor A. Both A and vertical velocity can vary with depth. A method is given for determining A as a function of depth from a continuous velocity log and a range of oblique shots into a well phone. Two examples are given, in one of which data obtained from larger shooting distances show that the simple A factor description is inadequate for higher angles of propagation direction.—D.B.V.

vanEverdingen, R. O. *See* Meyboom, Peter. 9612

9493 **VanValen, Leigh; Sloan, Robert E.** The extinction of the multituberculates: Systematic Zoology, v. 15, no. 4, p. 261–278, illus., tables, 1966.

Multituberculate mammals [western North America and elsewhere] declined in numerical abundance from late Cretaceous to their extinction in late Eocene. Their maximal diversity, however, occurred in late middle Paleocene, suggesting an increase in specialization in the face of competition from placental mammals. It is concluded that first condylarths, then primates, and finally rodents contributed to the gradual extinction of multituberculates, at least in part by evolution in the same region of competing resource requirements. A phylogeny of the Cenozoic Multituberculata and their ancestors is given, the mammal faunas of the Paleocene are listed by more or less their absolute ages, and the fauna of Bear Creek [Mont.] is analyzed in detail. A theory of replacement of supraspecific taxa is presented and applied.—*from* Authors' abstract

9924 **vanVeen, H. J.; Savino, J.; Alsop, L. E.** An optical maser strainmeter: Jour. Geophys. Research, v. 71, no. 22, p. 5478–5479, illus., 1966.

The principles of operation, first results, and some future possibilities of an optical maser strainmeter developed, built, and operated by the Lamont group are presented. A unique feature of the instrument is the fact that it gives an absolute strain measurement and so does not require calibration, although the problem of how well the strain in the rock is transmitted to the device still remains. It is believed that this is the first time seismic strains of the order of 10^{-9} have been observed over a distance of only 1 m.—D.B.V.

9799 **Vaughan, Philip A.** The crystal structure of the zeolite ferrierite: Acta Cryst., v. 21, pt. 6, p. 983–990, illus., tables, 1966.

A sample of the zeolite mineral ferrierite was found to have unit-cell dimensions $a=19.16$, $b=14.13$, $c=7.49$ A (unit-cell content approximately $Na_{1.5}Mg_2Si_{30.5}Al_{5.5}O_{72}\cdot H_2O$) and to belong to space group *Immm*. The crystal structure was determined from three-dimensional X-ray data. Channels whose size was defined by a ring of ten tetrahedra exist parallel to the *c* axis in the aluminosilicate framework. Another prominent feature is the existence of large cavities, which contain $Mg(H_2O)_6$ ions. Structurally, ferrierite most closely resembles mordenite and dachiardite. There is no evidence for ordering of metal atoms in the metal positions. It was not possible to locate the Na^+ ions or six of the eighteen water molecules.—Author's abstract

9640 **Vincent, Harold A.** Trace analysis by electrochemical stripping techniques, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. B: Nevada Bur. Mines Rept. 13, pt. B, p. 87–97, illus., 1966.

Samples for trace-element analysis may sometimes be available in large quantities but contain only a small amount of the sought-after elements, or only a small sample may contain the sought elements in major quantities. Standard electrochemical techniques generally are not adequate for determination of metals present in solution at less than the 10^{-5} molar level. Stripping analysis is one of a number of better techniques to circumvent the difficulties; it is a two-step process in which the species sought must first form at an electrode a deposit which can be removed. Analytical measurements are made at the second or removal step. Two of many variations in techniques—linear voltage scan stripping and constant current stripping—are described.—G.D.C.

9720 **Vineyard, Jerry D.** Memorial to Maurice G. Mehl, 1887–1966: Missouri Speleology, v. 8, no. 2, p. 52–54, portrait, 1966.

9920 **Vivó Escoto, Jorge A.** Estudios profesionales de geografía en la Universidad Nacional de México [also English text]: México Univ. Nac. Autónoma Anuario Geografía 1964, v. 4, p. 379–383, 1966.

The Department of Geography of the National University of Mexico, founded in 1932, reorganized in 1939, was renamed in 1958 the College of Geography. Among the study courses are: cosmography, physical geography, historical and physical geology with field work, oceanography, geomorphology, cartography and photogeology, statistics, and geophysics. There are also some selective courses on a higher level. The requirement for the Masters degree stresses courses in education and teaching; for a Doctor in Geography twelve semester courses (research seminars) are required, including natural resources of Mexico. The title of Licentiate, requiring a professional thesis and a foreign language, is a step below the Masters degree.—G.D.C.

9941 **Vivó Escoto, Jorge A.** La fisiografía de México y los problemas de su nomenclatura, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 200–208, table, 1966.

The evolution of physiographic nomenclature in Mexico, from colonial times to the present, is reviewed briefly. A table, from the 4th Congreso Nacional de Geografía, summarizes names used by various authors for the major regional features of Mexico.—G.D.C.

VonHuene, R. E. *See* Harrison, J. C. 9498

Voress, Hugh E. *See* Gerber, Carl R. 9636

9810 **Wachholz, H.** Poisson's constant with dry sediments and with packings of spheres: Geophys. Prosp. [Netherlands], v. 14, no. 2, p. 204–215, illus., 1966.

To find a relation between Poisson's constant of dry sediments and porosity it is necessary to consider the elastic behavior of the sediments' initial and the final states during the process of consolidation. Elastic constants of simple cubic and hexagonal packing of spheres, representing the initial state of sand and other loose granular materials, are calculated with the aid of an assumed adhesion for the contact planes and a derived elastic function of displacement due to a tangential force for the contact areas. Poisson's constant is then calculated from the formula valid for isotropic solids for three different directions of sound. With the known equation of Poisson's constant of low porosity rock, a third-degree polynomial is formed which agrees well with average values of known measurements, and can serve as a guide for calculating Poisson's constant of water-saturated sediments.—D.B.V.

9738 **Wagener, H. D.** Coarse-grained sillimanite-quartz rock associated with the Winnsboro Granites, Fairfield County, South Carolina: South Carolina Div. Geology Geol. Notes, v. 10, no. 3, p. 43–45, illus., 1966.

High-grade metamorphic rocks near the northern and northwestern boundaries of the Winnsboro Granite complex include fine-grained quartzites in which acicular sillimanite occurs in varying amounts. A thin section from an outcrop near the Winnsboro Blue Granite quarry has a mode of 52.1 percent quartz, 46.1 percent sillimanite, and 1.9 percent zircon. Most of the sillimanite crystals are linearly arranged in groups, intersecting at approximately 45°, from which quartz is largely excluded. The presence of aluminous materials in schist quartzites in this area probably reflects the original composition of the sediments from which they were derived.—B.S.H.

9746 **Wagener, H. D.** Origin of iron-manganese oxide nodules in the Winnsboro 15′ quadrangle, South Carolina: South Carolina Div. Geology Geol. Notes, v. 10, no. 3, p. 47–49, illus., 1966.

In the southeastern part of the Winnsboro quadrangle brown iron-oxide rich nodules occur in residual and transported soils associated with amphibolites. The nodules, generally round and 1/8 to 1/4 inch in diameter, litter the surfaces of fields, are concentrated in gullies, and occur as encrustations on cobbles of basic rocks where the soil is thin. A secondary origin is indicated by the encrustations on cobbles and the association with hydrous iron oxides precipitated in the B soil horizon. It is possible that the iron compounds were precipitated in a warmer Pleistocene climatic cycle or that they are precipitated at present in the rather warm climate of central South Carolina.—B.S.H.

Wagner, Carol D. *See* Durham, J. Wyatt, 9894

9707 **Wait, James R.** Some factors concerning electromagnetic wave propagation in the Earth's crust: IEEE Proc., v. 54, no. 8, p. 1020–1025, illus., table, 1966.

This paper is a brief survey of the geophysical considerations which govern propagation of electromagnetic waves in the Earth's crust. It is indicated that the electrical conductivity of crustal materials depends, in a very complicated manner, on moisture content, porosity, temperature, and pressure. It is suggested that communication ranges in the crust will seldom exceed 100 km except when basement rock conductivities are less than 10^{-6} mho/meter.—Author's abstract

9687 **Waller, Roger M.** Effects of the March 1964 Alaska earthquake on the hydrology of south-central Alaska: U.S. Geol. Survey Prof. Paper 544-A, p. A1–A28, illus., 1966.

Alaska's water resources were subjected to tremendous forces during the March 1964 earthquake, the greatest effects being confined to thick unconsolidated deposits about 200 mi from the epicenter. Seismic waves caused oscillations and turbidity in lakes, rivers, and shallow ground water 45 mi from the epicenter. Compressional waves caused eruptions of sediment-laden water in most alluvial areas within 100 mi and increased turbidity of artesian wells. Seismic shock or stresses caused changes in many aquifers that may be permanent. Long-term changes brought about by rearrangement of granular material, subsidence or elevation of landmasses, landslides, and formation of rock fractures and fissures, create new ground-water

flow patterns and lake levels, changes in stream gradients, and aggradation and erosion. Probably long-term effects are changes in aquifer yields and eventual deterioration of water quality.—*from* Author's summary

Walmsley, Victor G. *See* Boucot, A. J. 9751

Walters, Robert F. *See* Hilpman, Paul L. 0071

Walthall, Frank G. *See* Goldich, Samuel S. 9766

Wanless, R. K. *See* Larochelle, A. 9793

9506 **Ward, Stanley H.** Introduction [*to* The search for massive sulfides, Chap. 3], *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 117–129, illus., tables, 1966.

The term massive sulfides is defined as a single mass of at least 1,000 sq ft, made up of 50 percent or more sulfides, very dense, very conductive, and frequently magnetic. The importance of environment is stressed. In discussing the choice of technique for exploration, several case histories are reviewed, possible anomaly sources are tabulated, and successive elimination of extraneous sources discussed. Ward concludes that integrated exploration is the key to the ore search problems.—E.S.L.

0070 **Warner, L. A.; Robinson, C. S.** Geology of the Harold D. Roberts Tunnel, Colorado: Geol. Soc. America Bull., v. 78, no. 1, p. 87–119, illus., tables, 1967.

The Harold D. Roberts Tunnel is a 23.3-mile water-diversion tunnel that extends through the western part of the Front Range. The southeastern segment of the tunnel is mainly in Precambrian metamorphic and igneous rocks and partly in the Montezuma stock, a Laramide quartz monzonite pluton. The area traversed by the tunnel is crossed by two major Laramide structural elements—the Williams Range thrust fault and the Front Range mineral belt. Analysis of fault data in the tunnel indicates two complementary sets of northeast- and northwest-trending strike-slip faults which are apparently related to wrench faults that characterize the mineral belt. In the Montezuma stock, the fracture pattern conforms to the regional fault pattern. In the Precambrian rocks, however, minor faulting was controlled largely by the rock fabric, and the joints bear no obvious relation to faults or rock fabric.—D.H.W.

9718 **Washkurak, S.; Sawatzky, P.** The Serson direct-reading proton free-precession magnetometer—Pt. 2, Airborne use with telemetering and automatic diurnal correction: Canada Geol. Survey Paper 65-31, p. 33–75, illus., 1966.

At present, airborne magnetometer surveys are conducted during periods of relatively undisturbed magnetic diurnal variation, and magnetic control lines must be flown across survey lines at regular intervals to provide the necessary data for diurnal correction. With Telmag (telemetering magnetometer) a survey aircraft using a proton magnetometer telemeters the total magnetic intensity data to a base station where the magnetic diurnal is continuously and automatically removed. This paper describes the Telmag instrument that was developed by the Geological Survey of Canada and was tested on two separate surveys, one in Nova Scotia with a helicopter, and the other in northern Vancouver Island with a Beaver aircraft. Authors' abstract

9682 **Watts, William A.; Winter, Thomas C.** Plant macrofossils from Kirchner Marsh, Minnesota—A paleoecological study: Geol. Soc. America Bull., v. 77, no. 12, p. 1339–1359, illus., tables, 1966.

Plant macrofossils from cores previously used for pollen analysis are plotted in the style of pollen diagrams. Zone A, the oldest, is analogous to the existing Boreal Forest in southern Manitoba and is characterized by abundant *Picea* and *Larix* needles; other plants suggest swampy lake shores, silty lakes, or forest floors. *Betula papyrifera and Abies balsamea* replace these in Zone B, which also contains reed swamp and aquatic indicators. Subzones in Zone C indicate several drought periods,

some of which exposed the lake floor, before ultimate return to deep-water conditions. Seeds are not as suitable as pollen for statistical study because they are less efficiently mixed; but some seed diagrams show enough evidence of crude mixing to be analyzed by the pollen method if used with reservation.—J.G.V.

9601 **Waugh, Truman C.** Analyses of high-calcium chert-free beds in the Keokuk Limestone, Cherokee County, Kansas: Kansas Geol. Survey Bull. 180, pt. 2, 7 p., illus., table, 1966.

Chemical and physical examination of the chert-free portions of the Keokuk Limestone (Mississippian) in Cherokee County, Kans., showed it to be a high purity, low silica, low iron limestone of commercial quality. It is estimated that about 1 1/4 million tons of the high-calcium limestone are present. Analyses are included. Loss on ignition rate was shown to increase when the samples were calcined under a nitrogen atmosphere.—*from* Author's abstract

9868 **Weaver, J. D.** Higher level erosion surfaces in the Caribbean, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 10-12, 1966.

Further work on the higher level surfaces deduced from altimetric curves in Puerto Rico has suggested the possibility of large eustatic sea level changes since late Miocene times. Comparison of levels in Puerto Rico with those observed by Martin-Kaye in the Lesser Antilles and Choubert in French Guiana lead to this conclusion. Heezen's hypothesis of an expanding Earth accompanied by widening oceanic rifts is shown to be adequate, not only to explain such large eustatic falls of sea level, but, if accepted, to render them inevitable.—Author's abstract

9875 **Weaver, J. D.** Some remarks on the origin of the "Nipe Clay" in Puerto Rico, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 70, 1966.

The Nipe Clay of Puerto Rico, a dark reddish brown material containing numbers of rounded fragments of ironstone (perdigones), forms a blanket overlying serpentine and spilite on Las Mesas and Guanajibo ridges; it has been thought to be residual. Evidence accumulated to show that it is sedimentary and that the perdigones are pebbles composed of lateritic crust includes: unconformities between typical Nipe and underlying saprolite, the fact that Nipe does not always overlie serpentine, and the chemical analyses. Sediments from which most Nipe is derived are associated with three erosion surfaces: 330 m, 270 m, and 125 m. The sediments may have originated as beach deposits formed on a wide bench and later reworked subaerially.—E.S.L.

Webster, G. D. *See* Lane, N. Gary, 9865

9632 **Weege, Randall J.; Pollock, James P.** Exploration methods in the Copper Country, Keweenaw Peninsula, Michigan, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. C: Nevada Bur. Mines Rept. 13, pt. C, p. 51-61, illus., 1966.

Many prehistoric diggings led early explorers to native copper. First production at the Cliff mine followed study by the Michigan Geological Survey in 1841. Initial search was directed to high-angle fissures; then, by trenching and tracing float, to lava flows laterally identifiable over many miles. The Calumet Conglomerate, major producer, was similarly inspected. In the 1880's the diamond drill was extensively used, and sections drilled across the "Mineral Range". About 1923 a classification of flows, based on mineralogical and structural favorabilities, was not applicable. Deep testing of fissures for mother lode was disheartening. Recent search for lateral extensions of known offshoots has been successful on the Kearsarge lode, but less so elsewhere. Diamond drilling discovered the Kinston Conglomerate, and significant finds 3,400 feet down dip. Induced polarization aids ore finding in the Osceola lode.—G.D.C.

Weis, P. L. *See* MacLaren, D. R. 9671

Weissenborn, A. E. *See* MacLaren, D. R. 9671

0019 **Wetherbee, Mrs. Julian.** Mt. Monadnock and the glaciers: Earth Sci., v. 20, no. 1, p. 19–21, illus., 1967.

This is a popular account of the pre-glacial and glacial history, geomorphology, petrology, and mineralogy of Mt. Monadnock, New Hampshire.—E.S.L.

9878 **Weyl, Richard.** Orogenesis in Central America, *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 91–94, illus., 1966.

Central America and the West Indies can be considered as a geotectonic unit, with the Yucatán Peninsula considered a foreland. In the mountainous region of the north, a Paleozoic crystalline core crops out, sedimentation is mostly Cretaceous, and folding is germanotype with intensity decreasing in comparison to Mexico and the Antillean arc. In the south, older crystallines occur only on Santa Elena Peninsula, the next oldest rocks being the pre-Eocene Basal or Nicoya Complex. Stratigraphy of the Cretaceous-Tertiary geosynclinal sequence of Nicaragua, and Tertiary of Costa Rica and Panama are given. The S-shaped bend of the Isthmus is divided into two independent arcs, each with a series of fold systems. Strong post-orogenic plutonism has occurred in the south with extrusion in the north. In both areas, block faulting is the latest phase, with dissection of the peneplains.—E.S.L.

9644 **Weyler, Paul A.** Silicate analysis by X-ray spectrography, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. B: Nevada Bur. Mines Rept. 13, pt. B, p. 99–112, illus., tables, 1966.

In a recent investigation of the Sand Springs Range area, a nuclear device was detonated deep in a granite pluton about 28 miles southeast of Fallon, Nev. The Nevada Mining Analytical Laboratory analyzed samples of core from a 4-inch hole drilled near the shot point prior to the test. The procedures and results given in this paper have been extracted largely from the Shoal report (1963). Table 2 shows the range of composition and related statistics for seven oxides in the 34 samples of granite. Considering the qualifications, it appears reasonable to expect that a complete quantitative silicate analysis, including major trace elements, can be accomplished with but two machines (the X-ray spectrograph and the neutron generator) in hours as contrasted with days for wet chemical methods.—G.D.C.

Wheeler, W. H. *See* Daniels, R. B. 9606

9627 **Wheeler, Walter H.** A mosasaur mandible from the Black Creek Formation, Cretaceous, of North Carolina [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 82, no. 2, p. 92–93, 1966.

9752 **Whitcomb, James H.** Shear-wave detection in near-surface seismic refraction studies: Geophysics, v. 31, no. 5, p. 981–983, illus., tables, 1966.

It is shown that in refraction surveying, SH-waves can be detected at distances less than 200 m in volcanic flows, ash, and rubble, and in clastic rocks with varying degrees of cementation, by using angular accelerometers with sensitivities of 0.1 mv per rad per sec^2.—D.B.V.

9497 **White, P. S.** Airborne electromagnetic survey and ground follow-up in northwestern Quebec, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 252–261, illus., 1966.

An exploration sequence is outlined from the initial airborne electromagnetic survey to the final evaluation by diamond drilling. The exploration history is considered noteworthy in that the results of a variety of exploration methods are presented. Data are shown from surveys using airborne electromagnetics, ground electromagnetics, ground magnetics, and gravity; from diamond drill logs; and from laboratory measurements of specific gravity and resistivity. The conductor

discovered is of special interest in that it changes from massive sulfides at the first drill site to graphitic sediments at the second. The discovery of the massive pyrrhotite body is testimony to the technical success of this exploration program.—Author's abstract

Whitten, E. H. Timothy. *See* Beckman, W. A., Jr. 9928

Wilde, Garner L. *See* Skinner, John W. 9637

Wildeman, Thomas R. *See* Haskin, Larry A. 9815

9915 **Williams, P. J.** Downslope soil movement at a sub-arctic location with regard to variations with depth [with French abs.]: Canadian Geotech. Jour., v. 3, no. 4, p. 191–203, illus., table, 1966.

Soil movements due to solifluction-type processes have been investigated at Schefferville, Quebec, where the variation of movement with depth below the surface was especially considered. Tubes up to 2 m long were inserted vertically in the ground on three slopes in 1958, and checked the next three years. Permafrost was only 5 feet below the surface in places. One quite steep slope, up to 23°, although susceptible to frost heave and abundant water, showed no movement. Movements at the surface of over 10 cm/yr were recorded on a 20° bare slope. A lobate feature with 8–10° slope bent the tubes into a concave downslope form. Movements varied in intensity from year to year, decreased with depth, and were not measurable below 1 m. A stability calculation commonly used for engineering would not have indicated movements of this magnitude.—E.S.L.

9654 **Wilmoth, Benton M.** Ground water in Mason and Putnam Counties, West Virginia: West Virginia Geol. and Econ. Survey Bull. 32, 152 p., illus., tables, 1966.

The most productive aquifer in the area is the glacial-outwash alluvium of the Ohio River valley in Mason County. High yields (average 200 gpm) are available and the storage capacity of the reservoir is large. The aquifer provides water for several large industries and municipalities but is largely undeveloped. Most of the Kanawha River floodplain is untested but large supplies are probably available along most stretches of the river. The average yield of high capacity wells in this area is about a third of the average yield of the Ohio River alluvium. Water from the alluvial deposits is generally satisfactory for use although it is hard and somewhat high in iron. Pennsylvanian and Permian sandstones supply water for rural and suburban homes, farms, and small businesses throughout much of the area. Detailed logs of selected wells and test borings are included.—B.S.H.

0092 **Wilson, L. R.** Technique for illustrating palynological succession in sedimentary deposits: Oklahoma Geology Notes, v. 27, no. 1, p. 9–13, illus., 1967.

Palynomorph stratigraphic assemblages can be compared as single points and can indicate trends in local paleoecology, paleogeography, and paleoclimatology by the technique described. Data from a post-glacial peat deposit near Greenfield, Mass., is used as a demonstration. "The technique utilizes the bar-graph histogram from which relative values of each stratigraphic level are developed into cumulative curves on a second graph. The point of each cumulative curve at the median quartile is then transferred to a third, or quartile-summary graph. The resulting curve is a summary of median-quartile points and indicates the quantitative status of the palynomorph assemblage at each stratigraphic level and its relation to all others." The graph technique can be adapted also to bore-hole studies, heavy mineral investigations, and many types of neoecological studies.—B.S.H.

9753 **Wilson, L. R.** Stain technique for studying silicified-wood sections: Oklahoma Geology Notes, v. 26, no. 11, p. 274–276, illus., 1966.

Definition of cellular details in colorless silicified-wood sections is difficult to obtain and study by transmitted light in the compound microscope. This difficulty can be overcome by the use of stained Hoyer's solution as a mountant. A preparation of Hoyer's solution and stain—0.05 gm of Bismarck brown to 10 gm of Hoyer's solution—results in a dark reddish-brown solution which is adequate for staining

most silicified-wood sections. The stain should be spread uniformly on a dry microscope section and a cover glass placed over it immediately. The section is ready for study but it is not a permanent mount until it has dried for several days in an oven at 40°C.—B.S.H.

Wilson, W. F. *See* Allen, E. P. 9624

Wilson, W. L. *See* Lawrence, E. F. 9579

Windisch, Charles. *See* Ewing, John. 9902

9895 **Windley, B. F.** Superposed deformations of the Ketilidian gneisses in the Sârdloq area, South Greenland: Medd. om Grønland, v. 179, no. 3, 55 p., illus., table, geol. map, 1966.

The Sardloq area is underlain by intercalated horizons of homogeneous gneiss, veined gneisses, and banded gneiss of Precambrian age. The Ketilidian orogeny produced three generations of folds: (a) rootless intrafolial folds often in tectonic inclusions within the regional foliation; (b) widespread plastic folding of the regional foliation which took place largely in the veined gneiss horizons under syn-migmatization and amphibolite facies conditions; (c) large-scale buckling of the foliation under post migmatization and epidote-amphibolite facies conditions. A tectonic mélange was locally formed in response to the third phase movements. A structural correlation is made with the neighboring areas. Geologic and structural maps are included.—B.S.H.

9642 **Wines, S. Vernon; Papke, Keith G.** Exploration and operations as applied by Huntley Industrial Minerals, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. B: Nevada Bur. Mines Rept. 13, pt. B, p. 17-24, illus., 1966.

This paper deals principally with some of the aspects of the exploration program, and touches only generally on the mining and processing of industrial minerals. A vacuum drill, briefly described, can deposit relatively uncontaminated samples as stratified material in one of two plastic tubes. The geology and exploration of two of the Company's properties are covered: the Hot Creek (Little Antelope) kaolin deposit, 38 miles northwest of Bishop, Calif.; and the Overton magnesite deposit in Clark County, Nev. The kaolin, formed by hydrothermal alteration, occurs in lower beds of lacustrine vitric tuff and in underlying Pliocene(?) rhyolite, near hot springs. The magnesite, a part of the Horse Spring Formation of Tertiary(?) age, is of sedimentary origin and grades upward into soft dolomite of similar physical properties.—G.D.C.

9582 **Winkler, Erhard M.** Corrosion rates of carbonate rocks for construction: Eng. Geology, v. 3, nos. 1-2, p. 52-58, illus., 1966.

"The Langelier Saturation Index for carbonate rocks is evaluated and compared with the older, more quantitative Baylis saturation curve, which is considered more practical for engineers, as the degree of undersaturation of $CaCO_3$ can be easily read from the curve in parts per million $CaCO_3$ if the pH and $CaCO_3$ content of the water are known." The solubility of rainwater, running water, and sea water are compared and solution rates correlated with the chemical composition of natural waters. Water hardness, pH, and degree of solvent motion chiefly determine the corrosiveness of natural waters.—M.S.T.

Winter, T. C. *See* Maclay, R. W. 0016

Winter, Thomas C. *See* Watts, William A. 9682

9631 **Wisser, Edward.** The epithermal precious-metal province of northwest Mexico, *in* AIME Pacific Southwest Mineral Industry Conf., Sparks, Nev., 1965, Papers, Pt. C: Nevada Bur. Mines Rept. 13, pt. C, p. 63-92, illus., tables, geol. map, 1966.

The Mexican volcanic province, coextensive with the Sierra Madre Occidental, coincides with the greatest epithermal silver province in the world. This report

describes that portion north of 23° N. latitude, from which gross production has exceeded 1.5 billion dollars in silver and gold. Ore districts lie mainly along the crest of a long, narrow southeast trending anticline into which the volcanics have been upfolded, with branching spurs and superimposed local uplifts. Tensional fissures, widening as they climbed, became loci for precious-metal bearing veins. Erosion has exposed volcanic horizons at varying elevations. Vein deposits far above the basement are high in gold as compared to silver, with abundant quartz and sparse base-metal sulfides; those closer to the basement are relatively rich in silver, with abundant base metals and scanty quartz.—G.D.C.

Wood, Leonard A. *See* Moore, John E. 0108

9932 **Woodring, W. P.** The Panamá land bridge as a sea barrier: Am. Philos. Soc. Proc., v. 110, no. 6, p. 425–433, illus., tables, 1966.

This paper deals with the biogeography of the Caribbean marine faunal province during Tertiary time, based on Mollusca. There was no Panama land bridge during most of the Tertiary, although it was present by early Pleistocene. The Tertiary Caribbean province included the Panamanic province and the eastern Pacific and western Atlantic waters; parts of southern Central America were submerged during much of the Tertiary, and all of it may have been in the Eocene. Results of a census of 980 genera and subgenera of mollusks are plotted showing paciphile, total, and Caribbean taxa. The earliest paciphiles appeared in the late Eocene and disappeared by Quaternary; those now recognized and their age range in the province are tabulated. An appendix gives formations by ages and principal publications on each used in compiling the census.—E.S.L.

9800 **Woolacott, Robert M.** *Ceriocava eastoni*, sp. nov., the first described species of Bryozoa from the Cretaceous of California: Southern California Acad. Sci. Bull., v. 65, no. 4, p. 225–228, illus., 1966.

The first occurrence of Bryozoa in the Cretaceous of California is described from the Santa Ana Mountains. *Ceriocava eastoni* sp. nov., a cyclostome bryozoa, was found 0.50 mi east of Santiago Canyon Road on Williams Canyon Road in a loose boulder of fossiliferous sandstone from the Holz Shale Member of the Ladd Formation of Late Cretaceous age. This new species differs from other species of the genus in having a slight amount of horizontal striation in the outer zoecia and only moderate development of vesiculation in the outer zoecial walls. Unfortunately, the specimens examined lacked ovicells, and without knowledge of their character a complete description is impossible.—M.S.T.

Worzel, J. Lamar. *See* Ewing, John. 9902

9880 **Wozab, David H.; Patchick, Paul F.** Progress report—United Nations groundwater exploration project in El Salvador, C. A., *in* Caribbean Geol. Conf., 3d, Kingston, Jamaica, 1962, Trans.: Jamaica Geol. Survey Pub. 95, p. 98–103, illus., 1966.

A two-year ground-water exploration and evaluation project is being conducted in the lower basin of the Río Grande de San Miguel, which constitutes a complete hydrologic unit. However, there is continuity of the free water table with the coastal plain in the western portion of the area. A volcanic chain bounds the area to the north, and impermeable intrusives to the east, south, and west. A broad synclinal depression, faulted along one limb is suggested. The center is underlain by Pleistocene lacustrine tuffaceous silts. The water table averages 83 feet in depth in the center of the basin, and the aquifer, 158 feet thick, is composed of pumice, ash, and lapilli. Pumping tests showed capacities varying from 10 gpm/ft of drawdown to 85 gpm/ft. The probability of artesian conditions at depth is confirmed by geologic mapping.—E.S.L.

Wright, C. W. *See* Spencer, W. K. 9907

9568 **Wright, Cynthia Roseman.** Environmental mapping of the beds of the Liverpool cyclothem in the Illinois basin and equivalent strata in the northern mid-continent region [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1523B, 1966.

0096 **Wright, Thomas L.** Geological exploration in 1966, *in* The search for ore: Mining Eng., v. 19, no. 2, p. 65–67, illus., 1967.

Exploration for practically all the metals continued at a high rate. Numerous important discoveries with significant new reserves of ore were announced. Substantially increased interest in uranium was noted.—F.C.C.

9569 **Wu, Francis Taming.** Pt. 1—Lower limit of the total energy of earthquakes and partitioning of energy among seismic waves; Pt. 2—Reflected waves and crustal structures [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1523B, 1966.

Wyatt, Philip. *See* Fischer, Irene. 9502

9779 **Wyckoff, Jerome.** Rock, time, and landforms: New York, Harper and Row, 372 p., illus., 1966.

This book about landscapes, suggesting new ways of looking at familiar scenes, is for nonspecialists: the passenger in the jetliner, spelunker in the cave, hiker on the mountain, stroller on the beach, rockhound driving across the desert, and the week-end sailor along the coast. Liberally illustrated with photographs and diagrams, and including a glossary, it provides a useful reading-reference book on geography, geology, and environment. The geomorphic processes are described as well as the landform features in various realms both continental and marine, and the materials that compose them. The millions of years in the making are emphasized, and the conversion by man deplored.—G.D.C.

Wyckoff, Ralph W. G. *See* Doberenz, Alexander R. 9806

9756 **Wyllie, P. J.** High-pressure techniques, *in* Methods and techniques in geophysics, V. 2: London and New York, Interscience Publishers, p. 33–79, illus., 1966.

The literature on techniques of high-pressure research is sampled and presented in a complete but condensed form for the general reader. A brief summary is given of the history of this research and of the properties and processes within the Earth to be determined. Experimental apparatus described and illustrated includes hydrostatic externally and hydrostatic internally heated pressure vessels, externally and internally heated uniaxial systems, and internally heated multipiston arrays. Some of the results as to physical properties of minerals and rocks, polymorphic transistions and solid-solid reactions, dissociation reactions, and melting reactions are outlined to demonstrate the range of data obtainable with the techniques given. A list of 117 references is included.—V.S.N.

9653 **Wyrick, Granville G.** Ground-water resources of Martin County, North Carolina: North Carolina Dept. Water Resources Ground-Water Bull. 9, 85 p., illus., tables, 1966.

Ground water in Martin County occurs in seven principal aquifers of sand, shell, and limestone beds of the Cretaceous Tuscaloosa and Black Creek Formations, the Paleocene Beaufort Formation, the Eocene Castle Hayne Limestone, and Quaternary surficial deposits. Water in the lower six aquifers is under artesian conditions and is generally of good quality and in sufficient amounts for most purposes. The average transmissibility of the artesian aquifers ranges from 4,000 gal per day per ft to 18,000 gal per day per ft. The average daily recharge to these aquifers is computed as 22 million gal per day for aquifers between 100 feet and 300 feet below land surface. Water from Quaternary deposits is under non-artesian conditions and is of poor quality because of large amounts of dissolved iron.—B.S.H.

9835 **Yagi, Kenzo.** Discussion of paper by J. A. O'Keefe and E. W. Adams, "Tektite structure and lunar ash flows" [1965]: Jour. Geophys. Research, v. 71, no. 22, p. 5492–5493, table, 1966.

It is pointed out in discussion of the above paper (ibid., v. 70, p. 3819–3829, 1965) that lunar ash flows would correspond to terrestrial "ash falls" and would not show the textural features of welded tuffs; if some tektites are similar in structure to welded tuffs, the terrestrial origin rather than the lunar is supported. Observations of the

1962 eruption of Tokachi in Japan suggest that quartz grains could not be concentrated in ash flows by grain-size sorting; the formation of almost pure deposits of quartz grains for the parent materials of Libyan Desert glass or Darwin glass would be impossible on the Moon. Finally, the chemical composition of tektites is different from that of the known differentiates of basaltic magma, the only possible source of acidic material on the Moon.—D.B.V.

9617 **Yarza de De la Torre, Esperanza.** Los gases y vapores volcánicos de Baja California, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 2: México, D. F., Soc. Mexicana Geografía y Estadística, p. 246–255, illus., 1966.

The Valle de Mexicali, consisting of hardened deposits of deltaic origin, is the site of three zones of hydrothermal springs and volcanic gases which may become important sources of geothermal energy. These zones coincide with a straight line through which is believed to run a fault of the San Andreas system; the Valle de Mexicali is compared with the Salton Sea region. The depth of alluvial soil in Mexicali may be 2,500 m, most of it from the Colorado River basin and Grand Canyon. Two test wells indicate possible energy production of 20,000 and 35,000 KW; for the first of these an analysis of the mixed vapor is given.—G.D.C.

9786 **Yochelson, Ellis L.** Some new Permian gastropods from Spitsbergen and Alaska: Norsk Polarinst. Arb. 1965, p. 31–35, illus., 1966.

A specifically indeterminate *Omphalotrochus* from southern Spitsbergen is the northernmost record of this widely ranging genus. The new genus *Nordospira* is proposed for other Spitsbergen specimens, with *N. henningsmoenae* new species, as type. The new specific name *N. vostokovae* is applied to previously described but unnamed specimens from northern Alaska.—Author's abstract

9802 **Yochelson, Ellis L.** A reinvestigation of the middle Devonian gastropods *Arctomphalus* and *Omphalocirrus*: Norsk Polarinst.-Arb. 1965, p. 37–47, illus., 1966.

Arctomphalus, from the Eifelian strata of Ellesmere Land [Northwest Territories], is distinguished from the Givetian genus *Omphalocirrus*, which occurs in the Rhine valley. Specimens of both genera are large, and ornamented by spines on a circumbilical ridge, but differ in whorl profile and ornament pattern. The two genera are transferred from the Macluritidae to the Euomphalidae.—Author's abstract

Yoder, H. S., Jr. *See* Kushiro, I. 9818

Young, R. S. *See* Giannini, W. F. 9535

9851 **Ysalgué de Massip, Sarah E.** Las regiones geomorfológicas de Cuba, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 106–114, 1966.

Cuba is geomorphologically complex, showing effects of repeated transgression of the sea, recent tectonic activity, and various landforms characteristic of a tropical climate. There are at least three peneplanation levels, and erosional features of old age, maturity and youth. The classification of the island into geomorphic regions has been a subject of study for many years; the various physiographic divisions suggested since 1905 are reviewed here.—G.D.C.

9733 **Zablocki, C. J.** Electrical properties of some iron formations and adjacent rocks in the Lake Superior region, *in* Mining geophysics—V. 1, Case histories: Tulsa, Okla., Soc. Explor. Geophysicists, p. 465–492, illus., table, 1966.

Electrical resistivity, magnetic susceptibility, and gamma-ray intensity measurements were made of iron formations and associated rocks in the Cuyuna and Mesabi iron ranges of Minnesota, the Gogebic range of Wisconsin, and the Iron River district of Michigan. The measurements were made in drill holes and on core samples in the laboratory to provide information on physical properties for evaluating surface geophysical methods of prospecting. Electrical resistivity of the iron formations varies widely, and is a function of the porosity of the rock and type of iron material

in it. In general, rocks adjacent to iron-formation have much higher resistivity than rocks in the formation; an exception is the graphitic slate in the Iron River–Crystal Falls district. Magnetic susceptibility measurements show no direct relation between magnetite content and resistivity.—*from* Author's abstract

9859 **Zaborski, Jerzy.** La unidad espacial y la definición de las regiones montañosas—Un problema de taxonomía y nomenclatura, *in* Unión Geog. Internac. Conf. Regional Latinoamericana, Mexico, 1965, Proc., V. 3: México, D. F., Soc. Mexicana Geografía y Estadística, p. 625–627, 1966.

The three major mountain systems in North America are defined briefly. The Laurentian Shield, comprising several ranges in central Canada and the Adirondacks of New York, can be traced in the structural basement of the continent. The folded Appalachians, parallel to the Atlantic coast from eastern Canada and New England southwest into Alabama, appear to have subsurface connection with the Ozark–Ouachita mountains. The third system, including the alpine Rocky Mountains and younger western cordillera, extends the whole length of the Pacific coast of the New World. Numerous small ranges transverse the Ozark–Appalachian system at odd angles, carrying different names of local origin. Standardization of the nomenclature is suggested, recognizing spatial unity and differences in the regions.—G.D.C.

9775 **Zietz, Isidore; King, E. R.; Geddes, W.; Lidiak, E. G.** Crustal study of a continental strip from the Atlantic Ocean to the Rocky Mountains: Geol. Soc. America Bull., v. 77, no. 12, p. 1427–1447, illus., 1966.

A 100-mile strip from Denver, Colo., to Washington, D. C., reveals large magnetic anomalies of major crustal significance. The mafic rocks of the Blue Ridge and Piedmont and the Keweenawan mafic belt in Iowa and Nebraska give rise to strong linear trends, whereas a more random pattern of anomalies appears in other areas. Gravity and drill core data are utilized. Extension of Grenville-type lithology and metamorphism into Ohio is suggested and correlation with the mid-continent gravity high is apparent. Long-wavelength variations in the profile often show little relation to basement lithologic patterns and instead may indicate features originating in the upper mantle.—J.J.H.

9570 **Zimmerman, Ronald K.** Aspects of early Allegheny depositional environments in eastern Ohio [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 27, no. 5, p. 1523B, 1966.

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